ATTACHMENT (C)

National Telecommunications and Information Administration (NTIA) draft preliminary proposals, provided on behalf of the Executive Branch agencies.

WAC-23/050 (08.22.2022)

WAC-23/051 (08.22.2022)

WAC-23/050 (08.22.2022)

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration Washington, D.C. 20230

Mr. Tom Sullivan
Chief, International Bureau
Federal Communications
Commission 45 L Street NE
Washington, DC 20554

Dear Mr. Sullivan:

The National Telecommunications and Information Administration (NTIA), on behalf of the Executive Branch agencies, provides the attached WRC-23 Agenda Items 1.1 addressing protection of Aeronautical and Maritime Mobile Stations in the frequency band 4800-4990 MHz; 1.2 addressing mid-band IMT studies in the specific bands of 3.3 and 10.5 GHz; 1.8 addressing review and possible revision of Res. 155 (rev.WRC-19) and 5.484B in the frequency bands to which they apply; and 4 addressing Resolutions and Recommendations Review in accordance with Resolution 95.

NTIA looks forward to working with FCC in reconciling these proposals for submission to CITEL PCC II as U.S. proposals. Our point of contact is Mr. Charles Glass, NTIA's WRC Coordinator, who can be reached at (202) 714-1763 or cglass@ntia.gov.

Sincerely,

Steve Molina 9 August 2022

Steve Molina
Deputy Associate Administrator
Office of Spectrum Management

Enclosures (5)

UNITED STATES OF AMERICA
DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.1: to consider, based on the results of the ITU-R studies, possible measures to address, in the frequency band 4 800-4 990 MHz, protection of stations of the aeronautical and maritime mobile services located in international airspace and waters from other stations located within national territories, and to review the pfd criteria in No. **5.441B** in accordance with Resolution **223 (Rev.WRC-19)**;

I. BACKGROUND:

World Radiocommunication Conference 2015 (WRC-15) adopted No. **5.441B** which provides some countries with an identification for International Mobile Telecommunications (IMT) in the frequency band 4 800-4 990 MHz, or portions thereof, under certain conditions including the establishment of a power-flux density (pfd) limit to protect other mobile services. Technical studies to review this limit were conducted during the WRC-19 cycle; however, consensus was not reached. Discussions at WRC-19 resulted in a modification of No. **5.441B** to include additional countries in the footnote, and to further review the pfd limits at WRC-23. Resolution **223** was revised to include specific provisions relating to aircraft stations, fixed-service stations, and other ground-based stations of the mobile service operating in portions of the 4 800 – 4 990 MHz band through the following *resolves*:

*3 that in the frequency bands 4 800-4 825 MHz and 4 835-4 950 MHz, in order to identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by IMT stations in relation to aircraft stations, a coordination distance from an IMT station to the border of another country equal to 300 km (for land path)/450 km (for sea path) applies;*
*4 that in the frequency band 4 800-4 990 MHz, in order to identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by IMT stations in relation to fixed-service stations or other ground-based stations of the mobile service, a coordination distance from an IMT station to the border of another country equal to 70 km applies;*

In addition, WRC-19 decided that the pfd limits, which are subject to review at WRC-23, do not apply in certain countries through the following *resolves*:

*5 that the power flux-density (pfd) limits in No. **5.441B**, which is subject to review at WRC-23, shall not apply to the following countries: Armenia, Brazil, Cambodia, China, Russian Federation, Kazakhstan, Lao P.D.R., Uzbekistan, South Africa, Viet Nam and Zimbabwe.*

Some administrations heavily utilize portions of the 4.8-4.99 GHz frequency band for fixed and mobile (including aeronautical) applications. Many different systems are currently operating in this band, having had to migrate from lower bands in the past. One example is small UAS datalinks that were migrated to this band. In the United States, the 4 940-4 990 MHz band has been the focus of action to expand access, including various opportunities for commercial mobile service operations.

II. PROPOSAL:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD USA/1.1/1

4 800-5 250 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
4 800-4 990	FIXED MOBILE 5.440A 5.441A MOD 5.441B 5.442 Radio astronomy 5.149 5.339 5.443	

Reasons: See the modifications for No. **5.441B** below.

MOD USA/1.1/2

5.441B In Angola, Armenia, Azerbaijan, Benin, Botswana, Brazil, Burkina Faso, Burundi, Cambodia, Cameroon, China, Côte d'Ivoire, Djibouti, Eswatini, Russian Federation, Gambia, Guinea, Iran (Islamic Republic of), Kazakhstan, Kenya, Lao P.D.R., Lesotho, Liberia, Malawi, Mauritius, Mongolia, Mozambique, Nigeria, Uganda, Uzbekistan, the Dem. Rep. of the Congo, Kyrgyzstan, the Dem. People's Rep. of Korea, Sudan, South Africa, Tanzania, Togo, Viet Nam, Zambia and Zimbabwe, the frequency band 4 800-4 990 MHz, or portions thereof, is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. The use of IMT stations is subject to agreement obtained under No. 9.21 with concerned administrations, and IMT stations shall not claim protection from stations of other applications of the mobile service. In addition, before an administration brings into use an IMT station in the mobile service, it shall ensure that the power flux-density (pfd) produced by this station does not exceed in the band 4 800-4 990 MHz, −~~155~~134 dB(W/(m^2 · 1 MHz)) produced up to ~~19~~ 30 ~~k~~m above sea level and, in the band 4 800-4 950 MHz, −138 dB(W/(m^2 · 1 MHz)) produced from 30 m up to 19 km above sea level, at ~~20~~ 22 km from the coast, defined as the low-water mark, as officially recognized by the coastal State. ~~This pfd criterion is subject to review at WRC-23.~~ Resolution 223 (Rev.WRC-~~19~~23) applies. ~~This identification shall be effective after WRC-19.~~ (WRC-~~19~~23)

Reasons: The new pfd values in the modified 5.441B at 22 km from the coast are sufficient for the protection of AMS and MMS stations. There are two proposals for pfd in this footnote to accommodate the different receiver characteristics of AMS and MMS as well as the frequency bands these services are allowed to operate in. The new pfd values will raise the operational emissions of an IMT station by 17-21 dB relative to the current level allowing greater flexibility for the IMT operators while still maintaining protection for the AMS/MMS stations. The distance from the coast is changed to 22km to be more closely aligned with the edge of territorial sea as commonly recognized and provides additional propagation loss/higher emission level for an IMT station. Resolution **223** reference is updated to reflect modifications at WRC-23, if any. The

"subject to review" and "effective after WRC-19" sentences are obsolete once WRC-23 takes place and can be deleted.

MOD USA/1.1/3

III. RESOLUTION 223 (REV.WRC-~~19~~23)

Additional frequency bands identified for International Mobile Telecommunications

The World Radiocommunication Conference (~~Sharm el Sheikh~~TBD, UAE, 202~~3~~~~19~~),

considering

a) that International Mobile Telecommunications (IMT), including IMT-2000, IMT-Advanced and IMT-2020, is the ITU vision of global mobile access;

b) that IMT systems provide telecommunication services on a worldwide scale regardless of location, network or terminal used;

c) that IMT provides access to a wide range of telecommunication services supported by fixed telecommunication networks (e.g. public switched telephone network (PSTN)/integrated services digital network (ISDN), high bit rate Internet access), and to other services which are specific to mobile users;

d) that the technical characteristics of IMT are specified in ITU Radiocommunication Sector (ITU-R) and ITU Telecommunication Standardization Sector (ITU-T) Recommendations, including Recommendations ITU-R M.1457 and ITU-R M.2012, which contain the detailed specifications of the terrestrial radio interfaces of IMT;

e) that the evolution of IMT is being studied within ITU-R;

f) that the review of IMT-2000 spectrum requirements at WRC-2000 concentrated on the frequency bands below 3 GHz;

g) that at WARC-92, 230 MHz of spectrum was identified for IMT-2000 in the frequency bands 1 885-2 025 MHz and 2 110-2 200 MHz, including the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz for the satellite component of IMT-2000, in No. **5.388** and under the provisions of Resolution **212 (Rev.WRC-19)**;

h) that since WARC-92 there has been a tremendous growth in mobile communications including an increasing demand for broadband multimedia capability;

i) that the frequency bands identified for IMT are currently used by mobile systems or applications of other radiocommunication services;

j) that Recommendation ITU-R M.1308 addresses the evolution of existing mobile communication systems to IMT-2000, and that Recommendation ITU-R M.1645 addresses the evolution of the IMT systems and maps out their future development;

k) that harmonized worldwide frequency bands for IMT are desirable in order to achieve global roaming and the benefits of economies of scale;

l) that the frequency bands 1 710-1 885 MHz, 2 500-2 690 MHz and 3 300-3 400 MHz are allocated to a variety of services in accordance with the relevant provisions of the Radio Regulations;

m) that the frequency band 2 300-2 400 MHz is allocated to the mobile service on a co-

primary basis in the three ITU Regions;

n) that the frequency band 2 300-2 400 MHz, or portions thereof, is used extensively in a number of administrations by other services including the aeronautical mobile service (AMS) for telemetry in accordance with the relevant provisions in the Radio Regulations;

o) that IMT has already been deployed or is being considered for deployment in some countries in the frequency bands 1 710-1 885 MHz, 2 300-2 400 MHz and 2 500-2 690 MHz and equipment is readily available;

p) that the frequency bands 1 710-1 885 MHz, 2 300-2 400 MHz and 2 500-2 690 MHz, or parts thereof, are identified for use by administrations wishing to implement IMT;

q) that technological advancement and user needs will promote innovation and accelerate the delivery of advanced communication applications to consumers;

r) that changes in technology may lead to the further development of communication applications, including IMT;

s) that timely availability of spectrum is important to support future applications;

t) that IMT systems are envisaged to provide increased peak data rates and capacity that may require a larger bandwidth;

u) that ITU-R studies forecasted that additional spectrum may be required to support the future services of IMT and to accommodate future user requirements and network deployments;

v) that the frequency band 1 427-1 429 MHz is allocated to the mobile, except aeronautical mobile, service in all three Regions on a primary basis;

w) that the frequency band 1 429-1 525 MHz is allocated to the mobile service in Regions 2 and 3 and to the mobile, except aeronautical mobile, service in Region 1 on a primary basis;

x) that the frequency band 1 518-1 559 MHz is allocated in all three Regions to the mobile-satellite service (MSS) on a primary basis[1];

y) that WRC-15 identified the frequency band 1 427-1 518 MHz for use by administrations wishing to implement terrestrial IMT systems;

z) that there is a need to ensure the continued operations of the MSS in the frequency band 1 518-1 525 MHz;

aa) that appropriate technical measures to facilitate adjacent frequency band compatibility between the MSS in the frequency band 1 518-1 525 MHz and IMT in the frequency band 1 492-1 518 MHz need to be studied;

ab) Report ITU-R RA.2332, on compatibility and sharing studies between the radio astronomy service and IMT systems in the frequency bands 608-614 MHz, 1 330-1 400 MHz, 1 400-1 427 MHz, 1 610.6-1 613.8 MHz, 1 660-1 670 MHz, 2 690-2 700 MHz, 4 800-4 990 MHz and 4 990-5 000 MHz;

ac) that WRC-15 and this conference identified the frequency band 3 300-3 400 MHz for use by administrations wishing to implement terrestrial IMT systems in Nos. **5.429B**, **5.429D** and **5.429F**;

ad) that the frequency band 3 300-3 400 MHz is allocated worldwide on a primary basis to the radiolocation service;

ae) that a number of administrations use the frequency band 3 300-3 400 MHz, or portions thereof, which is allocated to the fixed and mobile services on a primary basis in No. **5.429**;

[1] See Table **21-4** for applicable pfd limits.

af) that the frequency band 4 800-4 990 MHz is allocated worldwide to the mobile and fixed services on a primary basis;

ag) that WRC-15 and this conference identified the frequency band 4 800-4 990 MHz for use by administrations wishing to implement terrestrial IMT systems in countries listed in Nos. **5.441A** and **5.441B**;

ah) that appropriate technical measures may be considered by administrations at a national level to facilitate adjacent frequency band compatibility between radio astronomy receivers in the frequency band 4 990-5 000 MHz and IMT systems in the frequency band 4 800-4 990 MHz,

emphasizing

a) that flexibility must be afforded to administrations:

- to determine, at a national level, how much spectrum to make available for IMT from within the identified frequency bands;
- to develop their own transition plans, if necessary, tailored to meet their specific deployment of existing systems;
- to have the ability for the identified frequency bands to be used by all services having allocations in those frequency bands;
- to determine the timing of availability and use of the frequency bands identified for IMT, in order to meet particular user demand and other national considerations;

b) that the particular needs of developing countries must be met;

c) that Recommendation ITU-R M.819 describes the objectives to be met by IMT-2000 in order to meet the needs of developing countries,

noting

a) Resolutions **224 (Rev.WRC-19)** and **225 (Rev.WRC-12)**, which also relate to IMT;

b) that the sharing implications between services sharing the frequency bands identified for IMT in No. **5.384A**, as relevant, will need further study in ITU-R;

c) that studies regarding the availability of the frequency band 2 300-2 400 MHz for IMT are being conducted in many countries, the results of which could have implications for the use of those frequency bands in those countries;

d) that, due to differing requirements, not all administrations may need all of the IMT frequency bands identified at WRC-07, or, due to the usage by and investment in existing services, may not be able to implement IMT in all of those frequency bands;

e) that the spectrum for IMT identified by WRC-07 may not completely satisfy the expected requirements of some administrations;

f) that currently operating mobile communication systems may evolve to IMT in their existing frequency bands;

g) that services such as the fixed service, the mobile service (second-generation systems), the space operation service, the space research service and the AMS are in operation or planned in the frequency band 1 710-1 885 MHz, or portions thereof;

h) that in the frequency band 2 300-2 400 MHz, or portions thereof, there are services such as the fixed, mobile, amateur and radiolocation services which are currently in operation or planned to be in operation in the future;

i) that services such as the broadcasting-satellite service (BSS), the BSS (sound), the MSS (in Region 3) and the fixed service (including multipoint distribution/communication systems) are in operation or planned in the frequency band 2 500-2 690 MHz, or portions thereof;

j) that the identification of several frequency bands for IMT allows administrations to choose the best frequency band or parts thereof for their circumstances;

k) that further study of the technical and operational measures regarding adjacent frequency band compatibility between IMT systems operating below 3 400 MHz and fixed-satellite service earth stations operating above 3 400 MHz may be required;

l) that ITU-R has identified additional work to address further developments in IMT;

m) that the IMT terrestrial radio interfaces as defined in Recommendations ITU-R M.1457 and ITU-R M.2012 are expected to evolve within the framework of ITU-R beyond those initially specified, to provide enhanced services and services beyond those envisaged in the initial implementation;

n) that the identification of a frequency band for IMT does not establish priority in the Radio Regulations and does not preclude the use of the frequency band for any application of the services to which it is allocated;

o) that the provisions of Nos. **5.317A**, **5.384A**, **5.388**, **5.429B**, **5.429D**, **5.429F**, **5.441A** and **5.441B** do not prevent administrations from having the choice to implement other technologies in the frequency bands identified for IMT, based on national requirements,

recognizing

that for some administrations the only way of implementing IMT would be spectrum refarming, requiring significant financial investment,

resolves

1 to invite administrations planning to implement IMT to make available, based on user demand and other national considerations, additional frequency bands or portions of the frequency bands above 1 GHz identified in Nos. **5.341B**, **5.384A**, **5.429B**, **5.429D**, **5.429F**, **5.441A** and **5.441B** for the terrestrial component of IMT; due consideration should be given to the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT, taking into account the services to which the frequency band is currently allocated;

2 to acknowledge that the differences in the texts of Nos. **5.341B**, **5.384A** and **5.388** do not confer differences in regulatory status;

3 that in the frequency bands 4 800-4 825 MHz and 4 835-4 950 MHz, in order to identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by IMT stations in relation to aircraft stations, a coordination distance from an IMT station to the border of another country equal to 300 km (for land path)/450 km (for sea path) applies;

4 that in the frequency band 4 800-4 990 MHz, in order to identify potentially affected administrations when applying the procedure for seeking agreement under No. **9.21** by IMT stations in relation to fixed-service stations or other ground-based stations of the mobile service, a coordination distance from an IMT station to the border of another country equal to 70 km applies;

~~5 that the power flux-density (pfd) limits in No. **5.441B**, which is subject to review at WRC-23, shall not apply to the following countries: Armenia, Brazil, Cambodia, China, Russian Federation, Kazakhstan, Lao P.D.R., Uzbekistan, South Africa, Viet Nam and Zimbabwe,~~

invites the ITU Radiocommunication Sector

1 to conduct compatibility studies in order to provide technical measures to ensure coexistence between the MSS in the frequency band 1 518-1 525 MHz and IMT in the frequency band 1 492-1 518 MHz, including guidance on the implementation of frequency arrangements

for IMT deployment in the frequency band 1 427-1 518 MHz, taking into account the results of these studies;

~~2 to study the technical and regulatory conditions for the protection of stations of the AMS and the maritime mobile service (MMS) located in international airspace or waters (i.e. outside national territories) and operated in the frequency band 4 800-4 990 MHz;~~

~~3~~2 to continue providing guidance to ensure that IMT can meet the telecommunication needs of developing countries and rural areas;

~~4~~3 to include the results of the studies mentioned in *invites the ITU Radiocommunication Sector* above in one or more ITU-R Recommendations and Reports, as appropriate,

~~*invites the 2023 World Radiocommunication Conference*~~

~~to consider, based on the results of the studies referred to in *invites the ITU Radiocommunication Sector* above, possible measures to address, in the frequency band 4 800-4 990 MHz, protection of stations of the AMS and MSS located in international airspace and waters from other stations located within national territories and to review the pfd criteria in No. **5.441B**.~~

Reasons: With the more relaxed pfd values in the modified 5.441B at 22 km from the coast, *resolves* 5 can be deleted to provide a more consistent regulatory condition to all administrations. The other modifications to the Resolution **223** are consequential after the agenda item 1.1 is satisfied at WRC-23.

~~**IV.**~~

~~**V.**~~**IV.**

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.2: *to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution **245 (WRC-19)**;*

BACKGROUND

Mobile broadband plays a crucial role in providing access to businesses and consumers worldwide. In 2020, the first year of the pandemic, the number of Internet users grew by 10.2 per cent, the largest increase in a decade, driven by developing countries where Internet use went up 13.3 per cent. According to ITU estimates, the number of active mobile-cellular telephone subscriptions per 100 inhabitants continues to grow strongly, reaching 110 subscriptions per 100 inhabitants, including a record number of mobile subscriptions with broadband capacity (3G or better).[2] Ninety-five percent of the world's population lives within reach of a mobile broadband service, and the relatively small difference in the number of subscriptions between developed and developing countries demonstrates that connectivity is a priority among people in countries at all levels of development.[3]

Fifth generation (5G) provides improved data rates and reduced latency. Importantly 5G has been designed to enable capabilities in a wide range of industries including healthcare, transportation, manufacturing, education, and telemedicine; 5G is expected to have a broad impact on our economies and societies. With demand for IMT applications continuing to increase, additional IMT spectrum identifications in the mid-range frequency bands – with its favourable mix of coverage and capacity - will need to be considered to enable future deployments, where these applications and services might be difficult to implement using lower or higher frequency bands.

<u>3 300-3 400 MHz</u>

In Region 2, the frequency band 3 300-3 400 MHz is allocated to the radiolocation service on a primary basis. The fixed service is allocated on a primary basis in seven Region 2 countries under footnote **5.429C**. The mobile, except aeronautical mobile, service is allocated on a primary basis in thirteen Region 2 countries under footnote **5.429C** with IMT identifications in these countries according to footnote **5.429D**.

[2] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2021.pdf

[3] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2021.pdf

Proposals:

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

NOC USA/1.2/3.3GHz/1

2 700-3 600 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
3 300-3 400 RADIOLOCATION 5.149 5.429 5.429A 5.429B 5.430	**3 300-3 400** RADIOLOCATION Amateur Fixed Mobile 5.149 5.429C 5.429D	**3 300-3 400** RADIOLOCATION Amateur 5.149 5.429 5.429E 5.429F

Reasons: U.S. studies have shown sharing between IMT and radiolocation systems is not feasible. Separation distances of 120 km or more are required for the protection of shipborne radar and separation distance of 130 km, or more is required for protection of land-based radars. Separation distances of 275-310 km or more are required for the protection of airborne radars, depending on the deployment of IMT BS bandwidth.

SUP USA/1.2/3.3GHz/2

RESOLUTION 245 (WRC-19)

Studies on frequency-related matters for the terrestrial component of International Mobile Telecommunications identification in the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz

Reasons: Consequential action.

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UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.2: *to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution **245 (WRC-19)**;*
~~VI.~~V.

~~VII.~~VI. **BACKGROUND**

Mobile broadband plays a crucial role in providing access to businesses and consumers worldwide. In 2020, the first year of the pandemic, the number of Internet users grew by 10.2 per cent, the largest increase in a decade, driven by developing countries where Internet use went up 13.3 per cent. According to ITU estimates, the number of active mobile-cellular telephone subscriptions per 100 inhabitants continues to grow strongly, reaching 110 subscriptions per 100 inhabitants, including a record number of mobile subscriptions with broadband capacity (3G or better).[4] Ninety-five percent of the world's population lives within reach of a mobile broadband service, and the relatively small difference in the number of subscriptions between developed and developing countries demonstrates that connectivity is a priority among people in countries at all levels of development.[5]

Fifth generation (5G) provides improved data rates and reduced latency. Importantly 5G has been designed to enable capabilities in a wide range of industries including healthcare, transportation, manufacturing, education, and telemedicine; 5G is expected to have a broad impact on our economies and societies. With demand for IMT applications continuing to increase, additional IMT spectrum identifications in the mid-range frequency bands – with its favourable mix of coverage and capacity - will need to be considered to enable future deployments, where these applications and services might be difficult to implement using lower or higher frequency bands.

10.0-10.5 GHz

In Region 2, the 10-10.5 GHz frequency range is allocated on a primary basis to the Earth exploration-satellite (active) and radiolocation services. Fixed and mobile services are allocated on a primary basis to numerous Region 2 countries under footnote **5.480**. In the U.S., there is federal use of the 10-10.5 GHz band for applications of the radiolocation service.

The United States also relies upon Earth exploration-satellite (passive) sensors operated by NASA and other space agencies in the nearby 10.6-10.7 GHz band, parts of which are shared with fixed and mobile, except aeronautical mobile, services, subject to Resolution **751 (WRC-07)**. The 10.68-10.7 GHz portion of the band is subject to footnote **5.340** and is also allocated to the radio astronomy service on a co-primary basis**.** Measurements collected in the 10.6-10.7 GHz frequency band are used to determine both rain rates and sea surface wind speeds, which have an important role in weather prediction and climate monitoring.

Proposals:

[4] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2021.pdf

[5] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2021.pdf

NOC USA/1.2/10GHz/1

ARTICLE 5

Frequency allocations

SECTION IV – TABLE OF FREQUENCY ALLOCATIONS

(SEE NO. **2.1**)

10-10.7 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
10-10.4 EARTH EXPLORATION-SATELLITE (active) 5.474A 5.474B 5.474C FIXED MOBILE RADIOLOCATION Amateur 5.474D 5.479	**10-10.4** EARTH EXPLORATION-SATELLITE (active) 5.474A 5.474B 5.474C RADIOLOCATION Amateur 5.474D 5.479 5.480	**10-10.4** EARTH EXPLORATION-SATELLITE (active) 5.474A 5.474B 5.474C FIXED MOBILE RADIOLOCATION Amateur 5.474D 5.479
10.4-10.45 FIXED MOBILE RADIOLOCATION Amateur	**10.4-10.45** RADIOLOCATION Amateur 5.480	**10.4-10.45** FIXED MOBILE RADIOLOCATION Amateur
10.45-10.5	RADIOLOCATION Amateur Amateur-satellite 5.481	

Reasons: U.S. studies have shown sharing between IMT and radiolocation systems is not feasible. Separation distances of 225 km or more are required from the edge of the IMT deployment for the protection of airborne radars. Additionally, U.S. studies have shown that compatibility between IMT and EESS (passive) is not feasible. Out-of-band emission levels of -40.4 dBW per 100 MHz or lower are required for the protection of EESS (passive) sensors.

SUP USA/1.2/10GHz/2

RESOLUTION 245 (WRC-19)

Studies on frequency-related matters for the terrestrial component of International Mobile Telecommunications identification in the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz

Reasons: Consequential action.

~~VIII.~~VII. UNITED STATES OF AMERICA

~~IX.~~VIII. DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.8: *to consider, on the basis of ITU-R studies in accordance with Resolution **171 (WRC-19)**, appropriate regulatory actions, with a view to reviewing and, if necessary, revising Resolution **155 (Rev.WRC-19)** and No. **5.484B** to accommodate the use of fixed-satellite service (FSS) networks by control and non-payload communications of unmanned aircraft systems.*

Background: Agenda item 1.8 was established to revise Resolution **155 (Rev.WRC-19)**. This resolution was initially adopted by WRC-15 on the use of geostationary-satellite networks in the fixed-satellite service in certain frequency bands for the control and non-payload communications (CNPC) of unmanned aircraft systems (UAS). Report ITU-R M.2171 identifies the spectrum requirements for unmanned aircraft (UA) command and non-payload communication (CNPC) that would be needed to support flight through non-segregated airspace.

Studies on technical and regulatory conditions carried out in advance of WRC-15 showed that the use of FSS networks for UA CNPC is feasible under certain conditions. These conditions include flight scenarios which were provided by ICAO and the existing FSS framework. Furthermore, ICAO studies showed that – based on given FSS characteristic envelopes – the FSS based UAS CNPC can be a working solution compliant to the Standards and Recommended Practices (SARPs) for the RPAS C2 Link[6].

WRC-15, under its agenda item 1.5, considered the possibility to use fixed-satellite service (FSS) networks to provide UAS CNPC links and adopted Resolution **155 (WRC-15)** in order to benefit the opportunity of using existing satellite transponders. Recognizing the need for further studies on regulatory provisions and technical criteria both within ICAO and ITU, WRC-15 decided that consideration of the outcome of these studies, also taking into account the progress obtained by ICAO in the completion of its SARPs on the use of FSS for the UAS CNPC links, would again be considered by WRC-23.

WRC-23 agenda item 1.8 was therefore established by WRC-19 to, in accordance with Resolution **171 (WRC-19)**, consider appropriate regulatory actions, with a view to reviewing and, if necessary, revising Resolution **155 (Rev.WRC-19)** and No. **5.484B** to accommodate the use of FSS networks by control and non-payload communications of unmanned aircraft systems.

On the basis of the studies called for by Resolutions **171 (WRC-19)** and **155 (Rev.WRC-19)** that define the conditions for operating in the FSS (see *resolves* 19 of Resolution **155 (Rev.WRC-19)**) in the frequency bands for which No. **5.484B** already applies, revisions to Resolution **155 (Rev.WRC-19)** and RR No. **5.484B** are proposed to accommodate the use of FSS networks by UAS CNPC systems.

Proposal:

MOD USA/1.8/1

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[6] In ICAO, an "unmanned aircraft system" (UAS) is referred to as a "*Remotely piloted aircraft system*" (RPAS), the CNPC link is referred to as *C2 Link* (Command and Control).

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

5.484B ~~Resolution **155 (WRC-15)*** shall apply~~This frequency band, may also be used for the control and non-payload communication of unmanned aircraft systems. Such use shall be limited to internationally standardized aeronautical systems and in accordance with Resolution **155 (Rev.WRC-23)**. (WRC-~~15~~23)

~~* *Note by the Secretariat:* This Resolution was revised by WRC-19.~~

Reason: Modification of the footnote improves the clarity to the services and systems for which it applies.

MOD USA/1.8/2

RESOLUTION 155 (REV.WRC-23~~19~~)

Regulatory provisions related to earth stations on board unmanned aircraft which operate with geostationary-satellite networks in the fixed-satellite service in certain frequency bands not subject to a Plan of Appendices 30, 30A and 30B for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces*

The World Radiocommunication Conference (~~Sharm el Sheikh~~XXX, 20~~19~~23),

considering

a) that the operation of unmanned aircraft systems (UAS) requires reliable control and non-payload communication (CNPC) links, in particular to relay air traffic control communications and for the remote pilot to control the flight;

b) that satellite networks may be used to provide CNPC links of UAS beyond the line-of-sight, as shown in Annex 1 to this Resolution;

c) that CNPC links between space stations and stations on board unmanned aircraft (UA) are ~~proposed~~ permitted to be operated under this Resolution in the primary fixed-satellite service (FSS) in frequency bands shared with other primary services, including terrestrial services, however that would not preclude the use of other available allocations to accommodate this application,

considering further

that UAS CNPC links relate to the safe operation of UAS and have to comply with certain technical, operational and regulatory requirements,

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* May also be used consistent with international standards and practices approved by the responsible civil aviation authority.

noting

a) that WRC-15 adopted Resolution **156 (WRC-15)** on the use of earth stations in motion communicating with geostationary satellite orbit (GSO) FSS space stations in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz;

b) that Report ITU-R M.2171 provides information on characteristics of UAS and spectrum requirements to support their safe operation in non-segregated airspace,

recognizing

a) that the UAS CNPC links will operate in accordance with international standards and recommended practices (SARPs) and procedures established in accordance with the Convention on International Civil Aviation;

b) that, in this Resolution, conditions are provided for operations of CNPC links without prejudging whether the International Civil Aviation Organization (ICAO) would be able to develop SARPs to ensure safe operation of UAS under these conditions;

c) that Section VI of Article **22** contains limits on equivalent isotropically radiated power at off-axis angles of 3 degrees or more for earth stations of a geostationary satellite network in the fixed-satellite service in the frequency bands 14-14.47 GHz and 29.5-30 GHz;

d) that terrestrial services operate in the frequency bands 10.95-11.2 GHz, 11.45-11.7 GHz, 11.7-12.1 GHz (Region 2), 12.1-12.2 GHz (on the territory of the country listed in No. **5.489**), 12.2-12.5 GHz (Region 3), 12.5-12.75 GHz (on the territory of the countries listed in No. **5.494** and in Region 3);

e) that terrestrial services also operate in the frequency bands 14.0-14.3 GHz (on the territory of countries listed in No. **5.505**), 14.25-14.3 GHz (on the territory of countries listed in No. **5.508**), 14.3-14.4 GHz (Regions 1 and 3), and 14.4-14.47 GHz;

f) that CNPC links using earth stations onboard unmanned aircraft are not subject to the regulatory provisions that apply to earth stations in motion (ESIM),

resolves

1 that ~~assignments to stations of~~ , for CNPC links using Earth stations onboard Unmanned Aircraft ("CNPC UA ES") communicating with a GSO FSS ~~networks operating in~~space station within the frequency bands 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) in Region 2, 12.2-12.5 GHz (space-to-Earth) in Region 3, 12.5-12.75 GHz (space-to-Earth) in Regions 1 and 3 and 19.7-20.2 GHz (space-to-Earth), and in the frequency bands 14-14.47 GHz (Earth-to-space) and 29.5-30.0 GHz (Earth-to-space), ~~may be used for UAS CNPC links in non-segregated airspace*, provided that~~ or parts thereof, are an application of the primary FSS and the following conditions ~~specified in *resolves* below are met;~~shall apply:

1.1 with respect to space services in the frequency bands referred to in *resolves* 1, the notifying administration of the GSO FSS network shall ensure that its CNPC UA ES complies with the following conditions:

1.1.1 with respect to satellite networks or systems of other notifying administrations, the CNPC UA ES characteristics shall remain within the envelope of characteristics of the typical earth stations associated with the satellite network with which the CNPC UA ES communicates;

1.1.2 that CNPC UA ES shall be designed and operated so as to be able to meet their required performance with interference caused by other satellite networks resulting from application of Articles **9** and **11** and the use of CNPC UA ES shall not cause more interference and shall not claim more protection than any typical earth station in that GSO FSS network;

~~* May also be used consistent with international standards and practices approved by the responsible civil aviation authority.~~

1.1.3 the operation of CNPC UA ES shall comply with the coordination agreements for the frequency assignments of the typical earth station of the GSO FSS networks obtained under the relevant provisions of the Radio Regulations, taking into account *resolves* 3.4;

~~2 that earth stations in motion on board UA may communicate with the space station of a GSO FSS network operating in the frequency bands listed in *resolves* 1 above, provided that the class of the earth station in motion on board UA is matched with the class of the space station and that other conditions of this Resolution are met (see also *instructs the Director of the Radiocommunication Bureau* 3 below);~~

~~3 that the frequency bands specified in *resolves* 1 shall not be used for the UAS CNPC links before the adoption of the relevant international aeronautical SARPs consistent with Article 37 of the Convention on International Civil Aviation, taking into account *instructs the Director of the Radiocommunication Bureau* 4;~~

~~4 that administrations responsible for an FSS network providing UA CNPC links shall apply the relevant provisions of Articles **9** (necessary provisions need to be identified or developed) and **11** for the relevant assignments, including, as appropriate, assignments to the corresponding space station, specific and typical earth station and earth station in motion on board UA, including the request for publication in the International Frequency Information Circular (BR IFIC) of items referred to in *resolves* 2 and the course of actions identified in that *resolves* in order to obtain international rights and recognition as specified in Article **8**;~~

1.1.4 for the implementation of *resolves* 1.1.1, the notifying administration for the GSO FSS networks with which the CNPC UA ES communicate shall, in accordance with this Resolution, send to the Radiocommunication Bureau (BR) information on assignments for which the UG station class shall be applied or, alternatively, the relevant Appendix **4** notification information related to the characteristics of the CNPC UA ES intended to communicate with those GSO FSS networks, together with the commitment that the CNPC UA ES operation shall be in conformity with the Radio Regulations, including this Resolution;

1.2 with respect to terrestrial services in the frequency bands referred to in *resolves* 1, the notifying administration of the GSO FSS network shall ensure that its CNPC UA ES complies with the following conditions:

1.2.1 receiving CNPC UA ES in the frequency bands referred to in *recognizing d)* shall be designed and operated so as to be able to accept the interference from stations of terrestrial services to which the frequency band is allocated when those stations of terrestrial services operate in accordance with the Radio Regulations;

1.2.2 transmitting CNPC UA ES in the frequency bands referred to in *recognizing e)* shall be designed and operated so as to not cause harmful interference to stations of terrestrial services to which the frequency band is allocated when those terrestrial stations operate in accordance with the Radio Regulations, and Annex 2 (see *instructs the Director of the Radiocommunication Bureau* 1) to this Resolution shall apply so as to set the conditions for protecting terrestrial services from harmful interference in neighbouring countries in these frequency bands;

1.2.3 higher pfd levels than those provided in Annex 2 produced by CNPC UA ES on the surface of the Earth within any administration shall be subject to the prior agreement of that administration;

1.3 that, in order to protect the radio astronomy service in the frequency band 14.47-14.5 GHz, the notifying administration of the GSO FSS network operating CNPC UA ES in accordance with this Resolution in the frequency band 14-14.47 GHz within line-of-sight of radio astronomy stations are urged to take all practicable steps to ensure that the emissions from CNPC UA ES in the frequency band 14.47-14.5 GHz do not exceed the level and percentage of data loss given in the most recent versions of Recommendations ITU-R RA.769 and ITU-R RA.1513;

~~5 that earth stations of UAS CNPC links shall operate within the notified and recorded technical parameters of the associated satellite network, including specific or typical earth stations of the GSO FSS network(s) as published by the Radiocommunication Bureau (BR);~~

~~6 that earth stations of UAS CNPC links shall not cause more interference to, or claim more protection from, other satellite networks and systems than specific or typical earth stations as indicated in *resolves* 5 as published by BR;~~

~~7 that, in order to apply *resolves* 6 above, administrations responsible for the FSS network to be used for UAS CNPC links shall provide the level of interference for the reference assignments of the network used for CNPC links upon request by an administration authorizing the use of UAS CNPC links within its territory;~~

~~8 that earth stations of UAS CNPC links of a particular FSS network shall not cause more interference to, or claim more protection from, stations of terrestrial services than specific or typical earth stations of that FSS network as indicated in *resolves* 5 that have been previously coordinated and/or notified under relevant provisions of Articles **9** and **11**;~~

2 that CNPC UA ES:

2.1 using station class UG are permitted to communicate with a space station of a GSO FSS satellite network operating in the frequency bands listed in *resolves* 1 and limited to the frequency bands listed in *resolves* 1 when communicating with a space station of a GSO FSS satellite network under this Resolution;

~~9 that the use of~~ 2.2 assignments of an FSS satellite network ~~for UAS CNPC links~~ shall not constrain other FSS satellite networks beyond those already imposed by typical earth stations associated with the network during the application of the provisions of Articles **9** and **11** nor ~~10 that the introduction of UAS CNPC links shall not~~ result in additional coordination constraints on terrestrial services under Articles **9** and **11**;

2.3 in the application of this Resolution does not provide a regulatory status different from that derived from the GSO FSS networks with which they communicate, taking into account the provisions referred to in this Resolution (see *resolves* 3.4);

~~11 that earth stations on board UA shall be designed and operated so as to be able to accept the interference caused by terrestrial services operating in conformity with the Radio Regulations in the frequency bands listed in *resolves* 1 without complaints under Article **15**;~~

~~12 that earth stations on board UA shall be designed and operated so as to be able to operate with interference caused by other satellite networks resulting from application of Articles **9** and **11**;~~

~~13~~3 that, in order to ensure freedom from harmful interference, that may affect ~~safety of flight~~ operation of UAS, the notifying administration~~s~~ of the GSO FSS network shall cooperate with the administration of the country in which the UA is registered ~~responsible for operating UAS CNPC links shall~~to:

~~–~~3.1 ensure that the use of ~~UAS CNPC links~~CNPC UA ES ~~be~~ is in accordance with international standards and recommended practices (SARPs) consistent with Article 37 of the Convention on International Civil Aviation;

~~–~~3.2 take the required measures, consistent with No. **4.10**, to ensure freedom from harmful interference to ~~earth stations on board UA~~CNPC UA ES and operated in accordance with this Resolution;

~~–~~3.3 act immediately when their attention is drawn to any such harmful interference, as freedom from harmful interference to ~~UAS CNPC links~~CNPC UA ES is imperative to ensure their safe operation, taking into account *resolves* ~~11~~ 1.2.1;

~~–~~3.4 use assignments associated with the GSO FSS networks for ~~UAS CNPC links~~CNPC UA ES (see Figure~~-~~1 in Annex 1), including frequency assignments to space stations, specific or typical earth stations and ~~earth stations on board UA~~CNPC UA ES (see *resolves* 2.2), that have been successfully coordinated under Article~~-~~ **9** (including provisions identified in *resolves* ~~4~~ 1.1.4) and recorded in the Master International Frequency Register (MIFR) with a favourable finding under Article **11**, including Nos. **11.31, 11.32** or **11.32A** where applicable, and except those frequency assignments that have not successfully completed coordination procedures under No. **11.32** by applying Appendix **5** § 6.d.i (see *instructs the Director of the Radiocommunication Bureau* 2);

~~ensure that real-time interference monitoring, estimation and prediction of interference risks and planning solutions for potential interference scenarios are addressed by FSS operators and UAS operators with guidance from aviation authorities;~~

~~14 that, unless otherwise agreed between the administrations concerned, UA CNPC earth stations shall not cause harmful interference to terrestrial services of other administrations (see also Annex 2 to this Resolution);~~

3.5 use techniques to maintain antenna pointing accuracy for the operation of CNPC UA ES with the associated GSO FSS satellites, without inadvertently tracking adjacent GSO satellites;

3.6 take all necessary measures so that CNPC UA ES are subject to permanent monitoring and control by a network control and monitoring centre (NCMC) or equivalent facility in order to comply with the provisions in this Resolution;

3.7 provide NCMC or equivalent facility permanent points of contact for the purpose of tracing any suspected cases of harmful interference from CNPC UA ES and to immediately respond to requests from the points of contact of authorizing administrations;

4 that the procedures in Section VI of Article **15** apply when:

4.1 CNPC UA ES causes harmful interference to stations of primary allocated services that are operating in accordance with the Radio Regulations;

4.2 CNPC UA ES receives harmful interference from stations of a primary allocated service that are not operating in accordance with the Radio Regulations;

4.3 CNPC UA ES receives harmful interference from stations of other than a primary allocated service.

5 that the notifying administration of the GSO FSS network shall ensure that the operation of CNPC UA ES within the territories, including territorial waters and territorial airspaces, of an administration shall be carried out only if authorized by that administration,

~~*15 that, in order to implement resolves 14 above, power flux-density (pfd) hard limits need to be developed for UAS CNPC links; possible examples of such provisional limits to protect the fixed service are provided in Annex 2; subject to agreement between the administrations concerned, that annex may be used for the implementation of this Resolution;*~~

~~*16 that the pfd hard limits provided in Annex 2 shall be reviewed and, if necessary, revised by WRC-23[1];*~~

~~*17 that, in order to protect the radio astronomy service in the frequency band 14.47-14.5 GHz, administrations operating UAS in accordance with this Resolution in the frequency band 14-14.47 GHz within line-of-sight of radio astronomy stations are urged to take all practicable steps to ensure that the emissions from the UA in the frequency band 14.47-14.5 GHz do not exceed the levels and percentage of data loss given in the most recent versions of Recommendations ITU-R RA.769 and ITU-R RA.1513;*~~

~~*18 to consider the progress obtained by ICAO in the process of preparation of SARPs for UAS CNPC links, to review this Resolution at WRC-23, taking into account the results of the implementation of Resolution **156 (WRC-15)**, and to take necessary actions as appropriate;*~~

~~*19 that the ITU Radiocommunication Sector (ITU-R) studies on technical, operational and regulatory aspects in relation to the implementation of this Resolution shall be completed, together with the adoption of relevant ITU-R Recommendations defining the technical characteristics of CNPC links and conditions of sharing with other services,*~~

~~*encourages administrations*~~

~~*1 to provide the relevant information where available in order to facilitate the application of resolves 6;*~~

~~[1] WRC-19 received a proposal from one regional organization regarding protection of the fixed service using a revised pfd mask as contained in Annex 2 section b). ITU-R is invited, in continuing its study on the implementation of this Resolution, to consider this mask and take necessary action as appropriate.~~

~~*2 to participate actively in the studies referred to in invites the ITU Radiocommunication Sector by submitting contributions to ITU-R,*~~

~~*invites the 2023 World Radiocommunication Conference*~~

~~*to consider the results of the above studies referred to in this Resolution with a view to reviewing and, if necessary, revising this Resolution, and take necessary actions, as appropriate,*~~

~~*invites the ITU Radiocommunication Sector*~~

~~*to conduct, as a matter of urgency, relevant studies of technical, operational and regulatory aspects in relation to the implementation of this Resolution*[1]~~,

instructs the Director of the Radiocommunication Bureau

1 upon receipt of the notification information referred to in *resolves* 1.1.4, the BR shall examine it with respect to conformity with *resolves* 1.1.1, the commitment received as required by *resolves* 1.1.4, conformity with *resolves* 3.4, and conformity with the power flux-density (pfd) limits on the Earth's surface specified in Annex 2 and with any agreements obtained as referred to in *resolves* 1.2.3;

2 if the finding from the examination in *instructs* 1 is favourable, the BR shall publish the modified or additional assignment along with the results of such examinations in the International Frequency Information Circular (BR IFIC) and the modified or additional assignment shall retain the priority date of protection with that of the existing assignment,

~~*to examine the relevant part of this Resolution requiring actions to be taken by administrations to implement this Resolution, with a view to sending it to administrations and posting it on the ITU website;*~~

~~*2 to present to subsequent WRCs a progress report relating to the implementation of this Resolution;*~~

~~*3 to define a new class of station in order to be able to process satellite network filings submitted by administrations for earth stations providing UA CNPC links, after the Resolution is implemented, in accordance with this Resolution, and publish the information as referred to in resolves 4;*~~

~~*4 not to process satellite network filing submissions by administrations with a new class of a station for earth stations providing UA CNPC links before resolves 1-12 and 14-19 of this Resolution are implemented;*~~

~~*5 to report to subsequent WRCs on the progress made by ICAO on the development of SARPs for UAS CNPC links,*~~

instructs the Secretary-General

~~t~~o bring this Resolution to the attention of the Secretary General of ICAO~~,~~

~~*invites the International Civil Aviation Organization*~~

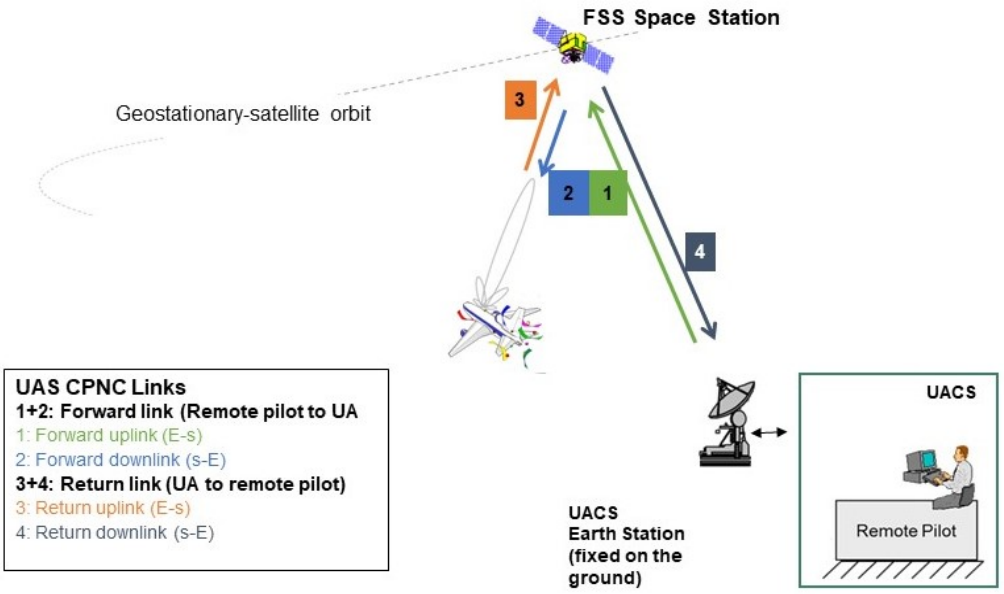
~~to provide to the Director of BR, in time for WRC-23, information on ICAO efforts regarding implementation of UAS CNPC links, including the information related to the development of SARPs for UAS CNPC links.~~

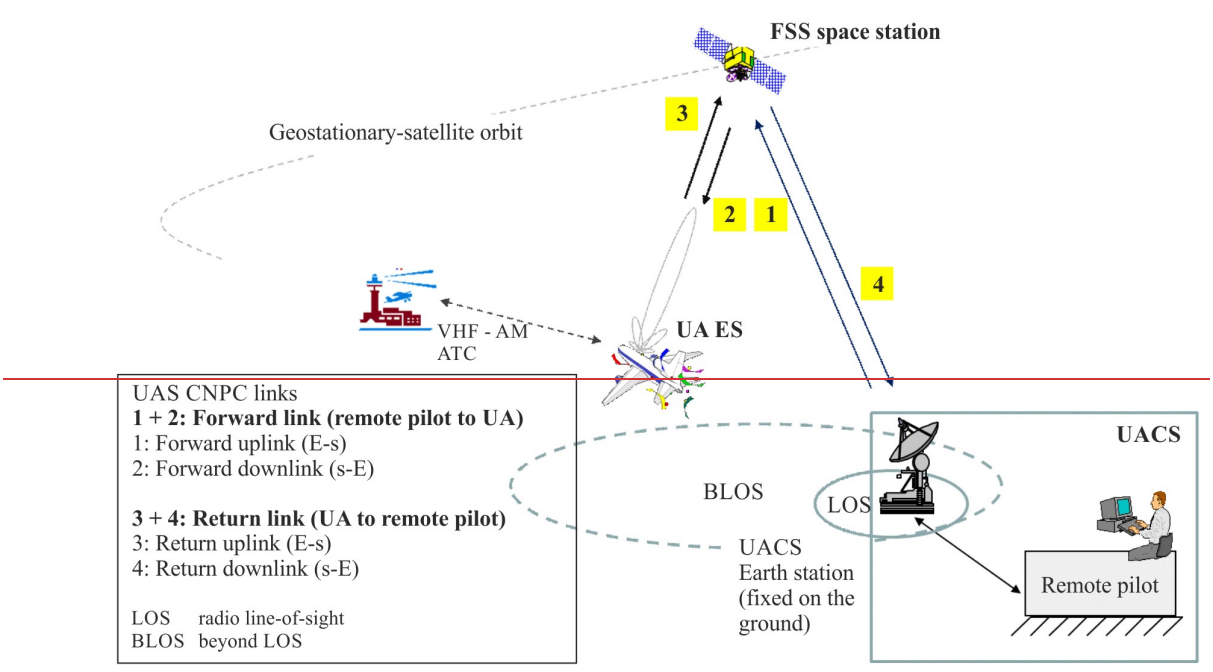
ANNEX 1 TO RESOLUTION 155 (REV.WRC-19)

UAS CNPC links

FIGURE 1

Elements of UAS architecture using the FSS





RES155_Annex1-01

ANNEX 2 TO RESOLUTION 155 (REV.WRC-~~19~~23)

Protection of ~~the fixed~~ terrestrial services from ~~UAS~~ CNPC UA ES emissions

~~**a) Example provided to WRC-15**~~

~~The fixed service is allocated by table entries and footnotes in several countries with co-primary status with FSS. Conditions of UA using CNPC shall be such that the fixed service is protected from any harmful interference as follows:~~

~~An earth station on board UA in the frequency band 14.0-14.47 GHz shall comply with provisional power flux-density (pfd) limits described below:~~

~~$-132 + 0.5 \cdot \theta$ dB(W/(m^2 · MHz)) for $0° \leq \theta \leq 40°$~~

~~-112 dB(W/(m^2 · MHz)) for $40° < \theta \leq 90°$~~

~~where θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal).~~

~~NOTE – The aforementioned limits relate to the pfd and angles of arrival that would be obtained under free-space propagation conditions.~~

~~**b) Example provided to WRC-19**~~

An earth station on board UA in the frequency band 14.0-14.3 GHz shall comply with the pfd limits described below, on the territory of countries listed in No. **5.505**:

$$15\log(\theta+0.9)-124 \text{ dB}\left(\text{W}/\left(\text{m}^2\cdot\text{MHz}\right)\right) \quad \text{for } 0° \leq \theta \leq 90°$$

where θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal).

An earth station on board UA:

– in the frequency band 14.25-14.3 GHz on the territory of countries listed in No. **5.508**;

– in the frequency band 14.3-14.4 GHz in Regions 1 and 3;

– in the frequency band 14.4-14.47 GHz worldwide,

shall comply with the pfd limits described below:

$$15\log(\theta+0.9)-133.5\text{dB}\left(\text{W}/\left(\text{m}^2\cdot\text{MHz}\right)\right) \quad \text{for } 0° \leq \theta \leq 90°$$

where θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal).
NOTE – The aforementioned limits relate to the pfd and angles of arrival that would be obtained under free-space propagation conditions.

Reason: Modifications to Resolution **155 (Rev.WRC-19)** removes provisions that are no longer required, improves clarity on actionable responsibilities, and eliminates duplications.

SUP USA/1.8/3

RESOLUTION 171 (WRC-19)

Review and possible revision of Resolution 155 (Rev.WRC-19) and No. 5.484B in the frequency bands to which they apply

Reason: Consequential action.

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~~X.~~IX. UNITED STATES OF AMERICA

~~XI.~~X. DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 4: *in accordance with Resolution **95 (Rev.WRC-19)**, to review the Resolutions and Recommendations of previous conferences with a view to their possible revision, replacement or abrogation;*

Background: Resolution 655 (WRC-15) tasked the ITU-R with studies and other work items related to the definition of time scale and dissemination of time scale via radiocommunication systems. This included strengthening the cooperation between ITU-R and BIPM, the International Committee for Weights and Measures (CIPM), CGPM, as well as other relevant organizations, and to carry out a dialogue concerning the expertise of each organization, to further and more widely study the various aspects of current and potential future reference time scales, including their impacts and applications, to provide advice on the content and structure of time signals to be disseminated by radiocommunication systems, using the combined expertise of the relevant organizations, and to prepare one or more reports containing the results of studies that should include one or more proposals to determine the reference time scale and address other issues mentioned previously.

This work, as originally proposed in Resolution **655 (WRC-15)**, is complete. The United States proposes changes to this Resolution to reflect the completion of the work items as well as to acknowledge the ongoing cooperation between the ITU and other relevant organizations in the various aspects of current and potential future reference time scales and the role of the ITU-R in the dissemination of the international reference time scale by radiocommunication. The United States also proposes adding CGPM Resolution 2 (2018) as an annex to Resolution **655 (WRC-15)**. This resolution of the CGPM is the basis for the roles of the ITU and other relevant organizations, under the memorandum of understanding between the ITU and the BIPM, in the definition of and dissemination of the international reference time scale. It is provided in an annex for reference.

Proposals:

MOD USA/4293A21/1

RESOLUTION 655 (Rev.WRC-2315)

Definition of time scale and dissemination of time signals via radiocommunication systems

The World Radiocommunication Conference (Dubai~~Geneva~~, 2023~~15~~),

considering

a) that the ITU Radiocommunication Sector (ITU-R) is responsible for the dissemination of time signals via radiocommunication for ~~defining~~ the standard frequency and time signal service and the standard frequency and time signal-satellite service ~~for the dissemination of time signals via radiocommunication~~;

b) that the International Bureau of Weights and Measures (BIPM) is responsible for establishing and maintaining the second of the International System of Units (SI) and its dissemination through the reference time scale;

c) that the definition of reference time scale and dissemination of time signals via radiocommunication systems are important for applications and equipment that require a time traceable to the reference time,

considering further

a) that ITU-R is an organization member of the Consultative Committee for Time and Frequency (CCTF) and participates in the General Conference on Weights and Measures (CGPM) as an observer;

b) that BIPM is a Sector Member of ITU-R and participates in the relevant activities of ITU-R,

noting

a) that the international reference time scale is the legal basis for time-keeping for many countries, and *de facto* is the time scale used in the majority of countries;

b) that disseminated time signals are used not only in telecommunications but also in many industries and practically all areas of human activities;

c) that time signals are disseminated by both wired communications covered by Recommendations of the ITU Telecommunication Standardization Sector (ITU-T) and by systems of different radiocommunication services (space and terrestrial), including the standard frequency and time signal service for which ITU-R is responsible,

recognizing

a) that No. **26.1** states that: “Attention should be given to the extension of this service to those areas of the world not adequately served”;

b) that No. **26.6** states that: “In selecting the technical characteristics of standard frequency and time signal transmissions, administrations shall be guided by the relevant ITU-R Recommendations”;

c) that the ~~current~~ original definition of the international reference time scale UTC resulted from work completed in 1970 by the International Radio Consultative Committee (CCIR) of the ITU, in full cooperation with the CGPM;

d) that the ITU World Administrative Radio Conference 1979 (WARC-79) included UTC in the Radio Regulations, and since then UTC, as "strongly endorsed" in Resolution 5 of CGPM (1975), has been used as the main time scale for telecommunication networks (wired and wireless) and for other time-related applications and equipment;

e) that the ITU and the BIPM entered into a memorandum of understanding[7] recognizing the respective responsibilities of the relevant unions and organizations towards the dissemination of the international reference time scale via telecommunication and the definition of the international reference time scale, as described in CGPM Resolution 2 (2018) in the Annex of this Resolution,~~;~~

resolves ~~*to invite the ITU Radiocommunication Sector*~~

1 to continue ~~strengthen~~ the cooperation between the ITU ~~R~~ and the BIPM, the International Committee for Weights and Measures (CIPM), CGPM, as well as other relevant organizations, and to carry out a dialogue concerning the various aspects of current and potential future reference time scales, including their impacts and applications, according to the expertise of each organization;

~~2 to further and more widely study in cooperation with the relevant international organizations, concerned industries and user groups, through the participation of the membership, the various aspects of current and potential future reference time scales, including their impacts and applications;~~

2~~3~~ to provide advice on the content and structure of time signals to be disseminated by radiocommunication systems, using the combined expertise of the relevant organizations, as described in the relevant ITU-R Recommendations,~~;~~

~~4 to prepare one or more reports containing the results of studies that should include one or more proposals to determine the reference time scale and address other issues mentioned in 1, 2 and 3 above,~~

~~*resolves*~~

~~that until WRC-23, UTC as described in Recommendation ITU-R TF.460-6 shall continue to apply, and for most practical purposes associated with the Radio Regulations, UTC is equivalent to mean solar time at the prime meridian (0° longitude), formerly expressed in GMT,~~

~~*instructs the Director of the Radiocommunication Bureau*~~

~~1 to invite the relevant international organizations such as the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO), CGPM, CIPM, BIPM, the International Earth Rotation and Reference Systems Service (IERS), the International Union of Geodesy and Geophysics (IUGG), the International Union of Radio Science (URSI), the International Organization for Standardization (ISO), the World Meteorological Organization (WMO) and the International Astronomical Union (IAU) to participate in the work mentioned in *resolves to invite the ITU Radiocommunication Sector*;~~

~~2 to report on the progress of this Resolution to WRC-23,~~

~~*invites the Director of the Telecommunication Development Bureau*~~

~~to assist the participation of developing countries in meetings, within approved budgetary resources,~~

~~*invites administrations*~~

~~to participate in the studies by submitting contributions to ITU-R,~~

~~*instructs the Secretary-General*~~

~~to bring this Resolution to the attention of IMO, ICAO, CGPM, CIPM, BIPM, IERS, IUGG, URSI, ISO, WMO and IAU.~~

Reasons: The work originally proposed in Resolution 655 (WRC-23) is complete. The resolves have been modified to emphasize the continuing cooperation between the ITU and other relevant

[7] The Memorandum of Understanding between the BIPM and ITU was signed by the President of the CIPM and the Director BR of the ITU in 2020

organizations in the various aspects of current and potential future reference time scales and the role of the ITU-R in the dissemination of the international reference time scale by radiocommunication.

ADD USA/4293A21/2

ANNEX TO RESOLUTION 655 (Rev.WRC-23)

CGPM Resolution 2 (2018)

On the definition of time scales

The General Conference on Weights and Measures (CGPM), at its 26th meeting,

considering that

– Resolution 1 adopted by the CGPM at its 14th meeting (1971) requested the CIPM to define International Atomic Time (TAI),

– no complete self-contained definition of TAI has been provided officially by the CIPM,

– the Consultative Committee for the Definition of the Second (CCDS) proposed in its Recommendation S2 (1970) a definition which was extended by a Declaration of the CCDS in 1980,

– the CGPM at its 15th meeting (1975) noted that Coordinated Universal Time (UTC), derived from TAI, provides the basis of civil time, and strongly endorsed this usage,

recognizing that

– the mission of the BIPM is to ensure and promote the global comparability of measurements, including the provision of a coherent international system of units,

– the International Astronomical Union (IAU) and the International Union of Geodesy and Geophysics (IUGG) with the International Association of Geodesy (IAG) are responsible for defining reference systems for Earth and space applications,

– the International Telecommunication Union Radiocommunication Sector (ITU-R) is responsible for coordinating the dissemination of time and frequency signals and making relevant recommendations,

– the International Earth Rotation and Reference Systems Service (IERS), a service of the IAU and IUGG, is responsible for providing information required to relate terrestrial and celestial reference systems, including time-varying measurements of the Earth's rotation angle, UT1 - UTC, the low-precision prediction of UT1 - UTC for time signal broadcasts, DUT1, and for deciding and announcing leap second insertions,

noting that

– Resolution A4 (1991) of the IAU defined, in Recommendations I and II, the Geocentric Reference System as a system of space-time coordinates for the Earth within the framework of general relativity, and, in Recommendation III, named the time coordinate of that reference system "Geocentric Coordinate Time" (TCG),

– Resolution A4 (1991) of the IAU further defined, in Recommendation IV, Terrestrial Time (TT) as another time coordinate in the Geocentric Reference System, differing from TCG by a constant rate; the unit of measurement of TT being chosen to agree with the SI second on the geoid,

– Resolution B1.9 (2000) of the IAU redefined TT to be a time scale differing from TCG by a constant rate: $d\mathrm{TT}/d\mathrm{TCG} = 1 - L_G$, where $L_G = 6.969290134 \times 10^{-10}$ is a defining constant (the numerical value of L_G was chosen to conform to the value $W_0 = 62636856.0\ \mathrm{m^2 s^{-2}}$ for the gravity potential on the geoid as recommended by Special Commission 3 of the IAG in 1999),

– the redefinition of TT in 2000 introduced an ambiguity between TT and TAI as the CCDS had stated in 1980 that TAI was to have "*the SI second as realized on the rotating geoid as the scale unit*" while the definition of TT does not refer to the geoid,

states that

– TAI is a continuous time scale produced by the BIPM based on the best realizations of the SI second, and is a realization of TT as defined by IAU Resolution B1.9 (2000),

– in the transformation from the proper time of a clock to TAI, the relativistic rate shift is computed with respect to the conventionally adopted equipotential $W_0 = 62636856.0$ m^2s^{-2} of the Earth's gravity potential, which conforms to the constant L_G defining the rate of TT,

– as stated in the IAU Resolution A4 (1991), TT - TAI = 32.184 s exactly at 1 January 1977, 0h TAI at the geocentre, in order to ensure continuity of TT with Ephemeris Time,

– UTC produced by the BIPM, based on TAI, is the only recommended time scale for international reference and the basis of civil time in most countries,

– UTC differs from TAI only by an integral number of seconds as published by the BIPM,

– users can derive the rotation angle of the Earth by applying to UTC the observed or predicted values of UT1 - UTC, as provided by the IERS,

– UTC provides a means to measure time intervals and to disseminate the standard of frequency during intervals in which leap seconds do not occur,

– traceability to UTC is obtained through local real-time realizations "UTC(*k*)" maintained by laboratories contributing data to the calculation of UTC, identified by "*k*",

confirms that

1 International Atomic Time (TAI) is a continuous time scale produced by the BIPM based on the best realizations of the SI second. TAI is a realization of Terrestrial Time (TT) with the same rate as that of TT, as defined by the IAU Resolution B1.9 (2000),

2 Coordinated Universal Time (UTC) is a time scale produced by the BIPM with the same rate as TAI, but differing from TAI only by an integral number of seconds,

and **recommends** that

– all relevant unions and organizations consider these definitions and work together to develop a common understanding on reference time scales, their realization and dissemination with a view to consider the present limitation on the maximum magnitude of UT1 - UTC so as to meet the needs of the current and future user communities,

– all relevant unions and organizations work together to improve further the accuracy of the prediction of UT1 - UTC and the method for its dissemination to satisfy the future requirements of users.

Reasons: This resolution of the CGPM is the basis for the roles of the ITU and other relevant organizations, under the memorandum of understanding between the ITU and the BIPM, in the definition of and dissemination of the international reference time scale. It is provided in this annex for reference.

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WAC-23/051 (08.22.2022)

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration Washington, D.C. 20230

Mr. Tom Sullivan
Chief, International Bureau
Federal Communications
Commission 45 L Street NE
Washington, DC 20554

Dear Mr. Sullivan:

The National Telecommunications and Information Administration (NTIA), on behalf of the Executive Branch agencies, provides the attached WRC-23 proposals for Agenda Item 1.6 addressing sub-orbital vehicles, 1.7 addressing a possible new allocation for AMS(R)S at 117.975-137 MHz, 1.10 addressing possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications, 1.17 addressing provisions for inter-satellite links, and 7 – Satellite regulatory issues – topic D addressing orbital separation in §§ 1.1 and 1.2 of Annex 4 of RR Appendix **30B**.

NTIA looks forward to working with FCC in reconciling these proposals for submission to CITEL PCC II as U.S. proposals. Our point of contact is Mr. Charles Glass, NTIA's WRC Coordinator, who can be reached at (202) 714-1763 or cglass@ntia.gov.

Sincerely,

Steve Molina 16 June 2022

Steve Molina
Deputy Associate Administrator
Office of Spectrum Management

Enclosures (5)

UNITED STATES OF AMERICA

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

Agenda Item 1.6

1.6 *to consider, in accordance with Resolution **772 (WRC-19)**, regulatory provisions to facilitate radiocommunications for sub-orbital vehicles;*

BACKGROUND INFORMATION:
WRC-19 recognized that stations on board sub-orbital vehicles may use systems operating under space and/or terrestrial services, and that the current regulatory provisions and procedures for terrestrial and space services may not be adequate for international use of relevant frequency assignments by stations on board suborbital vehicles. Some inconsistencies were raised during the preparations for WRC-23 agenda item 1.6, between the operational use of stations on-board suborbital vehicles, and the definitions of *terrestrial stations* in RR No **1.62**, *earth stations* in RR No **1.63**, and *space stations* in RR No **1.64**. Radio stations operating on-board suborbital vehicles are currently, and expected in the future, to operate both in frequency bands currently allocated for terrestrial radiocommunication services, and those allocated for space radiocommunication services. While in the RRs, each station shall be classified by the service in which it operates permanently or temporarily (RR No. **1.61)**, the suborbital vehicle may be physically located within the major portion of Earth's atmosphere or beyond for a brief period of time, but the physical location of the suborbital vehicle on which the stations are located does not necessarily change the need for, or purpose of, the use of specific radiocommunication services.

One objective of *Resolution **772 (WRC-19)*** is to facilitate radiocommunications necessary to safely integrate suborbital vehicles into the same airspace as conventional aircraft during their transition to and from space in order to minimize the airspace disruption. Studies found in Report ITU-R M.2477 show that suborbital vehicle activity requires making unavailable large areas of international and national airspace. This results in airspace disruptions, extra travel time, re-routing flight paths, and additional aircraft fuel consumption. The report shows the feasibility of using existing aircraft avionics systems by suborbital vehicles without modification of the existing Article 5 RR provisions. A WRC Resolution is proposed to clarify the use of frequencies necessary for the safe and efficient operation of suborbital vehicles.

ADD USA/A1.6/1

RESOLUTION [XYZ] (WRC-23)

Radiocommunication Services for Use by Stations On-board Suborbital Vehicles

The World Radiocommunication Conference (2023),

Considering

a) that sub-orbital vehicles operate at higher altitudes than conventional aircraft, with a sub-orbital trajectory;

b) that sub-orbital vehicles operate through the lower levels of the atmosphere, where they may operate in the same airspace as conventional aircraft;

c) that sub-orbital vehicles may perform various missions (e.g. conducting scientific research or providing transportation) and then return to the Earth's surface without completing a full orbital flight around the Earth;

d) that stations on board sub-orbital vehicles have a need for voice/data communications, navigation, surveillance, and telemetry, tracking and command (TT&C);

e) that sub-orbital vehicles must be safely accommodated into airspace used by conventional aircraft during certain phases of flight;

f) that there is a need to ensure that equipment installed on sub-orbital vehicles can communicate with air traffic management systems and relevant ground control facilities;

recognizing

a) that some sub-orbital flights could reach altitudes for a brief period of time in space without sufficient energy to sustain persistent orbit;

b) that there is no internationally agreed legal demarcation between the Earth's atmosphere and the space domain;

c) that Report ITU-R M.2477 describes sub-orbital flight as an intentional flight of a vehicle expected to reach the upper atmosphere with a portion of its flight path that may occur in space without completing a full orbit around the Earth before returning back to the surface of the Earth;

d) that Report ITU-R M.2477 describes a sub-orbital vehicle as a vehicle executing sub-orbital flight;

e) that stations on-board sub-orbital vehicles may use systems operating under space and/or terrestrial services;

f) that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices (SARPs) for aeronautical radionavigation and radiocommunication systems used by international civil aviation;

g) that most space launch systems may include components or items not reaching orbital trajectories, but some of these components or items may be developed as reusable items operating on sub-orbital trajectories;

noting

a) that Report ITU-RM.2477 provides information on radiocommunications for sub-orbital vehicles, including a description of the flight trajectory, categories of sub-orbital vehicles, technical studies related to possible avionics systems used by sub-orbital vehicles, and service allocations of those systems;

b) that the provisions of No. **4.10** may apply to certain aspects of sub-orbital vehicle operations;

c) that the development of compatibility criteria between International Civil Aviation Organization (ICAO) standardized aeronautical systems is the responsibility of ICAO;

resolves

1 that stations on-board suborbital vehicles may be terrestrial stations (RR No. 1.62) and earth stations (RR No. 1.63) and can be used in all phases of flight, within their respective service allocations (RR No. 1.61). The stations shall not impose any new constraints on applications of the same service and other radiocommunication services that are allocated on a primary basis.

instructs the Secretary-General

to bring this Resolution to the attention of ICAO.

invites the International Civil Aviation Organization

to take into account this Resolution and relevant portions of Report ITU-R M.2477 in the course of developing SARPs for ICAO systems that may be used by sub-orbital vehicles.

Reasons: This action will clarify that stations on-board suborbital vehicles may include terrestrial stations and earth stations and they can be used in all phases of flight, within their respective service allocations.

SUP USA/A1.6/2

RESOLUTION 772 (WRC-19)

Consideration of regulatory provisions to facilitate the introduction of sub orbital vehicles

Reasons: This resolution may be suppressed by WRC-23 because of a decision to add a new WRC Resolution clarifying the use of frequencies on-board suborbital vehicles.

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~~XII.~~XI. UNITED STATES OF AMERICA

~~XIII.~~XII. DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.7: *Studies on a possible new allocation to the aeronautical mobile-satellite (R) service within the frequency band 117.975-137 MHz in order to support aeronautical VHF communications in the Earth-to-space and space-to-Earth directions (WRC-19)*

BACKGROUND INFORMATION:

The frequency band 117.975- 137 MHz is allocated on a primary basis to the AM(R)S service and used for air-ground, ground-air and air-air systems, providing critical voice and data communications for air traffic management and airline operational control on a global basis. Resolution **428 (WRC-19)** invites WRC-23 to consider a new primary allocation to the AMS(R)S based on the results of sharing and compatibility studies. This new AMS(R)S service is intended to support direct pilot-air traffic controller voice as well as data communications in oceanic and remote areas without modifying aircraft equipment.

The AM(R)S allocation in 117.975-137 MHz supports Air Traffic Control (ATC) and Aeronautical Operational Control (AOC) systems for aircraft. This includes both standard voice communications but also datalink systems utilizing data messages for ATC and AOC functions to aircraft in the air and on the ground. There is significant utilization by terrestrial VHF systems within this allocation today, thus severely limiting options for new regional or national satellite frequency assignments that would need to be harmonized with existing terrestrial assignments.

The ITU-R studies carried out under Resolution **428 (WRC-19)** supports a recommendation for a new primary AMS(R)S service in the 117.975 – 136 MHz frequency band provided such an allocation is found to be compatible with existing services. The new allocation must protect existing primary services in and adjacent to the frequency band 117.975-137 MHz and should not constrain the planned usage of those systems.

PROPOSAL

Support a new primary AMS(R)S allocation in the 117.975 – 136 MHz frequency band, under Resolution **428 (WRC-19),** limited to relaying voice-only aeronautical air traffic control communications that operate in accordance with international standards and recommended practices and procedures established by the Convention on International Civil Aviation. Such use shall not cause harmful interference to nor claim protection from the AM(R)S systems operating in the frequency band 117.975-137 MHz. Satellite datalink applications using the AMS(R)S allocation within a portion of the frequency band 117.975-137 MHz may be considered by a future competent world radiocommunication conference.

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

MOD **USA/AI 1.7/1**

75.2-137.175 MHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="4">75.2-87.5
FIXED
MOBILE except aeronautical mobile

5.175 5.179 5.187</td><td colspan="2">75.2-75.4
FIXED
MOBILE
5.179</td></tr>
<tr><td>75.4-76
FIXED
MOBILE</td><td>75.4-87
FIXED
MOBILE

5.182 5.183 5.188</td></tr>
<tr><td rowspan="2">76-88
BROADCASTING
Fixed
Mobile

5.185</td><td rowspan="2">87-100
FIXED
MOBILE
BROADCASTING</td></tr>
<tr><td>87.5-100
BROADCASTING

5.190</td><td>88-100
BROADCASTING</td></tr>
<tr><td>100-108</td><td colspan="2">BROADCASTING
5.192 5.194</td></tr>
<tr><td>108-117.975</td><td colspan="2">AERONAUTICAL RADIONAVIGATION
5.197 5.197A</td></tr>
<tr><td>117.975-136<s>7</s></td><td colspan="2">AERONAUTICAL MOBILE (R)
<u>AERONAUTICAL MOBILE SATELLITE (R) ADD 5.A17</u>
5.111 5.200 5.201 5.202</td></tr>
<tr><td>136<s>17.975</s>-137</td><td colspan="2">AERONAUTICAL MOBILE (R)
5.111 5.200 5.201 5.202</td></tr>
</table>

ADD **USA/AI 1.7/2**

5.A17 The use of the band 117.975-136 MHz by the aeronautical mobile-satellite (R) service is limited to relaying voice-only aeronautical air traffic control communications that operate in accordance with international standards and recommended practices and procedures established by the Convention on International Civil Aviation. In assigning frequencies to stations of the aeronautical mobile-satellite (R) service, administrations shall take account of the frequencies assigned to stations of the aeronautical mobile (R) service. (WRC-23)

Reasons: Studies conducted under Resolution **428 (WRC-19)** have demonstrated that a new AMS(R)S allocation in the 117.975-136 MHz frequency band would provide benefits to aviation operations in oceanic and remote areas where ground-based communications are not feasible. Since the relay of air traffic control

voice communications is a supplement to ground-based stations, such use shall take account of the frequencies assigned to stations of the aeronautical mobile (R) service when assigning frequencies to stations of the aeronautical mobile-satellite (R) service.

SUP USA/A1.7/3

RESOLUTION 428 (WRC-19)

Studies on a possible new allocation to the aeronautical mobile-satellite (R) service within the frequency band 117.975-137 MHz in order to support aeronautical VHF communications in the Earth-to-space and space-to-Earth directions

Reasons: This resolution may be suppressed by WRC-23 because of a decision to add a new provision in Article **5** for AMS(R)S.

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~~XIV.~~XIII. UNITED STATES OF AMERICA

~~XV.~~XIV. DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.10: *to conduct studies on spectrum needs, coexistence with radiocommunication services and regulatory measures for possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications, in accordance with Resolution 430 (WRC-19)*

BACKGROUND INFORMATION:

Resolution **430 (WRC-19)**, calls for:

1) Sharing and compatibility studies in the 22-22.21 GHz frequency band, already allocated on a primary basis to mobile, except aeronautical mobile to determine if the "except aeronautical mobile" restriction can be revised or deleted, while ensuring the protection of primary services in the frequency bands considered and, as appropriate, in adjacent frequency bands.
2) Sharing and compatibility studies on a possible new primary allocation to the aeronautical mobile service (AMS) for non-safety aeronautical applications in the frequency band 15.4-15.7 GHz, while ensuring the protection of primary services in the frequency bands considered and, as appropriate, in adjacent frequency bands.
3) Definition of appropriate protection for passive services and the Radio Astronomy Service (RAS) allocated in adjacent frequency bands from unwanted emissions of the AMS.

The frequency band 15.4-15.7 GHz is widely used by the radiolocation (RLS) and aeronautical radionavigation services (ARNS) for critical applications. There has been a significant investment in support of the airborne radar applications within this frequency band. ITU-R past studies show sharing between RLS and AMS could be difficult, requiring extremely large separation distances. Additionally, the sub-band 15.43-15.63 GHz is allocated to the fixed-satellite service (space-to-Earth) on a primary basis for use by feeder links of non-geostationary systems in the mobile satellite service. The aeronautical radionavigation service in the 15.4-15.7 GHz band is used for landing systems and unmanned aircraft detect and avoid (DAA) systems. An ITU-R Recommendation is currently being developed to provide characteristics and protection requirements for these aeronautical radionavigation systems.

Sharing studies between aeronautical radionavigation systems and the radiolocation systems in the 15.4 -15.7 GHz frequency band show that sharing between non-safety AMS and radiolocation systems is not feasible due to a high transmitted EIRP limit from the non-safety AMS resulting in a large separation distance.

The 22-22.21 GHz frequency band under consideration is adjacent to the 22.21-22.5 GHz frequency band allocated to the Earth Exploration Satellite Service (passive). The 22.21-22.5 GHz frequency band allows for remote sensing observations near an H_2O absorption line that is essential not only for measuring atmospheric water vapor, but also for reducing error in other geophysical parameters due to the presence of water vapor.

Compatibility studies between non-safety AMS systems in the 22-22.21 GHz band and EESS (passive) systems in the 22.21-22.5 GHz band show that various AMS scenarios (e.g., wildfire observation and network-above-the-clouds) are not compatible with EESS (passive) operations based on the anticipated out-of-band emission levels from the non-safety AMS links.

The frequency band 22.21-22.5 GHz is also allocated to the RAS on a primary basis, and is subject to footnote **No 5.149**, which urges administrations to take all practicable steps to protect the RAS from harmful

interference. The radio astronomy service is extremely susceptible to interference from space and airborne transmitters (No. **29.12**).

PROPOSAL

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

NOC **USA/AI 1.10**

15.4 – 15.7 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
15.4-15.43	RADIOLOCATION 5.511E 5.511F AERONAUTICAL RADIONAVIGATION	
15.43-15.63	FIXED-SATELLITE (Earth-to-space) 5.511A RADIOLOCATION 5.511E 5.511F AERONAUTICAL RADIONAVIGATION 5.511C	
15.63-15.7	RADIOLOCATION 5.511E 5.511F AERONAUTICAL RADIONAVIGATION	

Reasons: Sharing studies between non-safety AMS and the incumbent services have been performed resulting in a large separation distance. The results show that it is not feasible for the non-safety AMS to obtain an allocation. Therefore, no change is proposed for the 15.4 – 15.7 GHz frequency band.

NOC **USA/AI 1.10**

22-22.21 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
22-22.21 FIXED MOBILE except aeronautical mobile 5.149		

Reasons: Compatibility studies between non-safety AMS and the incumbent services in the adjacent frequency band have been performed. The results show that various AMS scenarios (e.g., wildfire observation and network-above-the-clouds) are not compatible with EESS (passive) operations based on the anticipated out-of-band emission levels from the non-safety AMS links. Therefore, no change is proposed for the 22-22.21 GHz frequency band.

~~XVI.~~XV. UNITED STATES OF AMERICA

~~XVII.~~XVI. DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

AGENDA ITEM 1.17: *to determine and carry out, on the basis of ITU-R studies in accordance with Resolution **773 (WRC-19)**, the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate;*

Background

Space station operations in low-Earth orbit are increasing at a rapid rate for scientific, academic, and commercial purposes. These stations vary in size from as large as the International Space Station to as small as single unit cubesats[8] and have wide ranging data requirements. Users of these systems require moving data from space to Earth, or other satellite terminal locations in an efficient, fast, and cost-effective manner.

Considering the above, satellite manufacturers are developing technologies addressing this need, including the possible use of satellite-to-satellite links with transmissions limited to the same direction of transmission (e.g., Earth-to-space direction or space-to-Earth direction) of the GSO or non-GSO FSS service providers' space station.

The ITU-R has conducted extensive sharing and compatibility studies to assess the feasibility of introducing satellite-to-satellite links in many of the frequency bands called out in Resolution **773 (WRC-19)**. Based on these studies, the United States of America proposes that use of satellite-to-satellite links be recognized in the Radio Regulations within the fixed-satellite service in the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz with transmissions limited to the same direction of transmission (e.g., Earth-to-space direction or space-to-Earth direction) of the GSO or non-GSO FSS service providers' space station. Non-GSO user space stations using satellite-to-satellite links shall only transmit and receive within the cone of coverage[9] of the associated GSO or non-GSO FSS service provider space stations. Non-GSO user space stations will always operate at an orbital altitude that is lower than the orbital altitude of the FSS network or system with which it is communicating. The non-GSO user is to be part of the FSS network or system providing the service and will operate in a manner that would replicate the operations of other users of the FSS network or system. Other user space stations, e.g., a space science satellite, would include FSS frequencies and be part of the FSS network or system as a non-GSO space station under a contract with the FSS network or system operator providing the service.

A proposed new WRC-23 Resolution provides satellite-to-satellite link operating conditions and regulatory provisions to ensure protection of incumbent services operations.

The United States of America further proposes no change to the Radio Regulations for the frequency band 11.7-12.7 GHz due to lack of sufficient ITU-R studies supporting satellite-to-satellite link operations in this frequency range.

[8] A single unit cubesat has the dimensions of 10x10x10 centimeters and typical mass less than 2 kilograms.

[9] The cone of coverage is the conical volume of space defined by a cone whose apex is at the service provider space station and whose base does not extend beyond the edge of the notified service area of the individual service provider space station.

Proposals

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations
(See No. **2.1**)

NOC USA/4079A17/1

11.7-13.4 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="3">11.7-12.5
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.492

5.487 5.487A</td><td>11.7-12.1
FIXED 5.486
FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488
Mobile except aeronautical mobile
5.485</td><td rowspan="2">11.7-12.2
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE
5.492

5.487 5.487A</td></tr>
<tr><td>12.1-12.2
FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.488
5.485 5.489</td></tr>
<tr><td rowspan="2">12.2-12.7
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE 5.492

5.487A 5.488 5.490</td><td>12.2-12.5
FIXED
FIXED-SATELLITE (space-to-Earth) 5.484B
MOBILE except aeronautical mobile
BROADCASTING
5.487 5.484A</td></tr>
<tr><td>12.5-12.75
FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B (Earth-to-space)

5.494 5.495 5.496</td><td>12.7-12.75
FIXED
FIXED-SATELLITE (Earth-to-space)
MOBILE except aeronautical mobile</td><td>12.5-12.75
FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B
MOBILE except aeronautical mobile
BROADCASTING-SATELLITE 5.493</td></tr>
</table>

Reasons: Limited ITU-R studies were done in accordance with Resolution **773 (WRC-19)** supporting only satellite-to-satellite link operations in the downlink direction in the frequency range 11.7-12.7 GHz with no corresponding uplink direction spectrum.

MOD USA/4079A17/2

15.4-18.4 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
18.1-18.4	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.517A (Earth-to-space) 5.520 (space-to-space) ADD 5.A117 MOBILE 5.519 5.521	

Reasons: Include footnote in Article **5** recognizing satellite-to-satellite operations as part of the fixed-satellite service in the indicated frequency bands.

ADD USA/4079A17/3

5.A117 Space-to-space use is limited to transmissions in the space-to-Earth direction in the 18.1-18.6 GHz and 18.8-20.2 GHz frequency bands, and to transmissions in the Earth-to-space direction in the 27.5-30 GHz frequency band. Operations shall be in accordance with draft new Resolution **[USA/A17/SAT-TO-SAT] (WRC-23)**. No. 4.10 does not apply.

Reasons: New footnote recognizing satellite-to-satellite operations in the fixed-satellite service with provisions for operation specified in a new WRC-23 Resolution. Such use would not fall under the safety service provisions of Article **4.10**.

MOD USA/4079A17/4

18.4-22 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
18.4-18.6	FIXED FIXED-SATELLITE (space-to-Earth) 5.484A 5.516B 5.517A (Space-to-space) ADD 5.A117 MOBILE	
18.6-18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.517A 5.522B MOBILE except aeronautical mobile Space research (passive) 5.522A 5.522C	**18.6-18.8** EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.517A 5.522B MOBILE except aeronautical mobile SPACE RESEARCH (passive) 5.522A	**18.6-18.8** EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 5.517A 5.522B MOBILE except aeronautical mobile Space research (passive) 5.522A
18.8-19.3	FIXED FIXED-SATELLITE (space-to-Earth) 5.516B 5.517A 5.523A (Space-to-space) ADD 5.A117 MOBILE	

19.3-19.7	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 5.517A 5.523B 5.523C 5.523D 5.523E (space-to-space) ADD 5.A117 MOBILE	
19.7-20.1 FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A (space-to-space) ADD 5.A117 Mobile-satellite (space-to-Earth) 5.524	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A (space-to-space) ADD 5.A117 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528 5.529	**19.7-20.1** FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A (space-to-space) ADD 5.A117 Mobile-satellite (space-to-Earth) 5.524
20.1-20.2	FIXED-SATELLITE (space-to-Earth) 5.484A 5.484B 5.516B 5.527A (space-to-space) ADD 5.A117 MOBILE-SATELLITE (space-to-Earth) 5.524 5.525 5.526 5.527 5.528	

Reasons: Include footnote in Article **5** recognizing satellite-to-satellite operations as part of the fixed-satellite service in the indicated frequency bands.

MOD USA/4079A17/5

24.75-29.9 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
27.5-28.5	FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.539 (space-to-space) ADD 5.A117 MOBILE 5.538 5.540	
28.5-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.523A 5.539 (space-to-space) ADD 5.A117 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
29.1-29.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.517A 5.523C 5.523E 5.535A 5.539 5.541A (space-to-space) ADD 5.A117 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	

29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 (space-to-space) **ADD** 5.A117 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 (space-to-space) **ADD** 5.A117 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.525 5.526 5.527 5.529 5.540	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 (space-to-space) **ADD** 5.A117 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542

Reasons: Include footnote in Article **5** recognizing satellite-to-satellite operations as part of the fixed-satellite service in the indicated frequency bands.

MOD USA/4079A17/6

29.9-34.2 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
29.9-30	FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 **(space-to-space) ADD** 5.A117 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542	

Reasons: Include footnote in Article **5** recognizing satellite-to-satellite operations as part of the fixed-satellite service in the indicated frequency bands.

MOD USA/4079A17/7

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V – Limits of power flux-density from space stations

TABLE **21-4** (REV.WRC-~~19~~23)

Frequency band	**Service***	**Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane**				**Reference bandwidth**
		0°-5°	**5°-25°**		**25°-90°**	
13.4-13.65 GHz (Region 1)	Fixed-satellite (space-to-Earth) (geostationary-satellite orbit)	**0°-25°**	**25°-80°**	**80°-84°**	**84°-90°**	4 kHz
		−159 + 0.4δ [19]	−149 [19]	−149 − 0.5(δ − 80) [19]	−151 [19]	
17.7-19.3 GHz [7, 8]	Fixed-satellite	**0°-5°**	**5°-25°**		**25°-90°**	1 MHz

	(space-to-Earth) Fixed-satellite (space-to-space)[8bis] Meteorological-satellite (space-to-Earth)	−115 [14, 15] or −115 − X [13]	−115 + 0.5(δ − 5) [14, 15] or −115 − X + ((10 + X)/20) (δ − 5) [13]		−105 [14, 15] or −105 [13]	
17.7-19.3 GHz [7, 8]	Fixed-satellite (space-to-Earth) Fixed-satellite (space-to-space)	**0°-3°** −120 [16]	**3°-12°** −120 + (8/9) (δ − 3) [16]	**12°-25°** −112 + (7/13) (δ − 12) [16]	−105 [16]	1 MHz
19.3-19.7 GHz	Fixed-satellite (space-to-Earth) Fixed-satellite (space-to-space)	**0°-3°** −120 [16]	**3°-12°** −120 + (8/9) (δ − 3) [16]	**12°-25°** −112 + (7/13) (δ − 12) [16]	−105 [16]	1 MHz

TABLE **21-4** (*CONTINUED*) (REV.WRC-~~15~~23)

Frequency band	**Service***	**Limit in dB(W/m²) for angles of arrival (δ) above the horizontal plane**			**Reference bandwidth**
		0°-5°	**5°-25°**	**25°-90°**	
19.3-19.7 GHz 21.4-22 GHz (Regions 1 and 3) 22.55-23.55 GHz 24.45-24.75 GHz 25.25-27.5 GHz 27.500-27.501 GHz	Fixed-satellite (space-to-Earth) Fixed-satellite (space-to-space) Broadcasting-satellite Earth exploration-satellite (space-to-Earth) Inter-satellite Space research (space-to-Earth)	−115 [15]	−115 + 0.5(δ − 5) [15]	−105 [15]	1 MHz
31.0-31.3 GHz 34.7-35.2 GHz (space-to-Earth transmissions referred to in No. **5.550** on the territories of countries listed in No. **5.549**)	Space research	−115	−115 + 0.5(δ − 5)	−105	1 MHz
31.8-32.3 GHz	Space research	−120 [20]	−120 + 0.75(δ − 5) [20]	−105	1 MHz
32.3-33 GHz	Inter-satellite	−135	−135 + (δ − 5)	−115	1 MHz

Reasons: Include FSS (space-to-space) in Article **21**, Table **21-4** to ensure that pfd limits to protect terrestrial services that apply to FSS (space-to-Earth) also apply to FSS (space-to-space).

ADD USA/4079A17/8

[8bis] **21.16.2bis** That for the protection of the Earth exploration-satellite service (EESS) (passive) over oceans in the frequency band 18.6-18.8 GHz, Resolution [A117 FSS SAT-TO-SAT] (WRC-23) shall apply.

Reasons: Add a new provision in Article 21 to provide a pointer to Resolution [A117 FSS SAT-TO-SAT] (WRC-23) for protection of Earth exploration-satellite service (EESS) (passive) over oceans in the frequency band 18.6-18.8 GHz.

MOD USA/4079A17/9

Appendix 4 (REV WRC-~~19~~23)
Consolidate list and tables of characteristics for use in the
Application of the procedures of Chapter III

Annex 2
Characteristics of satellite networks, earth stations,
or radio astronomy stations

TABLE A

GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-~~19~~23)

Items in Appendix	*A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIO ASTRONOMY STATION*	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network or system subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network or system not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network or system	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.19.b	a commitment in accordance with *resolves* 1.5 of Resolution **156** (**WRC-15**) that the administration responsible for the use of the assignment shall implement *resolves* 1.4 of Resolution **156** (**WRC-15**) Required only for geostationary-satellite networks operating in the fixed-satellite sebrvice in the frequency bands 19.7-20.2 GHz and 29.5-30.0 GHz communicating with transmitting earth stations in motion				+						A.19.b	
A.20	**COMPLIANCE WITH *resolves* 1.1.4 OF RESOLUTION 169 (WRC-19)**										**A.20**	
A.20.a	a commitment that the ESIM operation would be in conformity with the Radio Regulations and Resolution **169 (WRC-19)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **169 (WRC-19)**				+						A.20.a	
A.21	**COMPLIANCE WITH *resolves* 1.2.6 OF RESOLUTION 169 (WRC-19)**										**A.21**	
A.21.a	a commitment that, upon receiving a report of unacceptable interference, the notifying administration for the GSO FSS network with which ESIMs communicate shall follow the procedures in *resolves* 4 of Resolution **169 (WRC-19)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **169 (WRC-19)**				+						A.21.a	
A.22	**COMPLIANCE WITH *resolves* 7 OF RESOLUTION 169 (WRC-19)**										**A.22**	
A.22.a	a commitment that aeronautical ESIMs would be in conformity with the pfd limits on the Earth's surface specified in Part II of Annex 3 to Resolution **169 (WRC-19)** Required only for the notification of earth stations in motion submitted in accordance with Resolution **169 (WRC-19)**				+						A.22.a	
A.23	**COMPLIANCE WITH RESOLUTION 35 (WRC-19)**										**A.23**	
A.23.a	a commitment stating that the characteristics as modified will not cause more interference or require more protection than the characteristics provided in the latest notification information published in Part I-S of the BR IFIC for the frequency assignments to the non-geostationary-satellite system				**O**						A.23.a	
A.24	**COMPLIANCE WITH NOTIFICATION OF A NON-GSO SHORT DURATION MISSION**										**A.24**	
A.24.a	a commitment by the administration that, in the case that unacceptable interference caused by a non-GSO satellite network or system identified as short-duration mission in accordance with Resolution **32 (WRC-19)** is not resolved, the administration shall undertake steps to eliminate the interference or reduce it to an acceptable level Required only for notification				+						A.24a	
A.25	**INCLUSION OF SPACE-TO-SPACE OPERATIONS**										**A.25**	
A.25.a	an indicator showing whether space-to-space operations in accordance with Resolution [USA/A17/SAT-TO-SAT] (WRC-23) with transmission in the 27.5-30.0 GHz bands, or parts thereof, and reception in the 18.1-18.6 and 18.8-20.2 GHz bands, or parts thereof, are included		**X**		**X**	**X**					A.25.a	
A.25.a.1	the calculated worst-case off-axis angle between the main lobe of the space station transmitting in the 27.5-30.0 GHz bands, or parts thereof, and the Earth surface		**X**		**X**	**X**					A.25.a.1	
A.25.b	an indicator showing whether space-to-space operations in accordance with Resolution [USA/A17/SAT-TO-SAT] (WRC-23) with transmission in the 18.1-18.6 and 18.8-20.2 GHz bands, or parts thereof, and reception in the 27.5-30.0 GHz bands, or parts thereof, are included		**X**		**X**	**X**					A.25.b	

Items in Appendix	*A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIO ASTRONOMY STATION*
A.25.b.1	an indicator for non-GSO systems receiving in the 27.5-28.6 GHz and 29.5-30.0 GHz bands showing the commitment that the equivalent power flux-density produced at any point in the geostationary-satellite orbit by emissions from all combined operations of space-to-space and typical Earth station transmissions shall not exceed the limits given in Table 22-2

Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network or system subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network or system not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network or system	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
	X		X	X					A.25.b.1	

Reasons: Four new Appendix 4 data elements are added to provide indicators for space-to-space operations for space stations operating in accordance with Resolution [USA/A17/FSS SAT-TO-SAT] (WRC-23)

ADD USA/4079A17/10

DRAFT NEW RESOLUTION [USA/A17/FSS SAT-TO-SAT] (WRC-23)

Use of 18.1-18.6, 18.8-20.2 and 27.5-30.0 GHz frequency bands for satellite-to-satellite transmissions in the fixed-satellite service

The World Radiocommunication Conference ([tbc], 2023),

considering

a) that there is a need for non-geostationary satellite orbit (non-GSO) space stations to be able to relay collected data to the Earth, and that part of this need could be met by allowing such non-GSO space stations to communicate with fixed-satellite service (FSS) space stations operating in the geostationary satellite orbit (GSO) and in the non-GSO in the 18.1-18.6 GHz, 18.8-20.2 and 27.5-30.0 GHz frequency bands, or parts thereof;

b) that **No. 1.21** states that, in some cases, the fixed satellite service includes satellite-to-satellite links

c) that the ITU Radiocommunication Sector (ITU-R) has carried out extensive sharing and compatibility studies between incumbent services in the 18.1-18.6 GHz, 18.8-20.2 GHz, and 27.5-30 GHz frequency bands and satellite-to-satellite transmissions in the fixed-satellite service;

d) that the frequency bands 18.1-18.6, 18.8-20.2 GHz (space-to-Earth) and 27.5-30.0 GHz (Earth-to-space) are also allocated to terrestrial and space services used by a variety of different systems, and these existing services and their future development need to be protected, without the imposition of undue constraints, from the operation of satellite-to-satellite links,

recognizing

that any course of action taken under this Resolution has no impact on the original date of receipt of the frequency assignments of the GSO FSS satellite network or the non-GSO FSS system with which non-GSO space stations communicate or on the coordination requirements of that satellite network,

resolves

1 that, for a non-GSO space station subject to this Resolution communicating with a GSO or non-GSO FSS space station within the frequency bands 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz, or parts thereof, the following conditions shall apply:

a) the non-GSO space station transmitting in the 27.5-30 GHz frequency bands and receiving in the 18.1-18.6 GHz and 18.8-20.2 GHz frequency bands shall only operate space-to-space links when its apogee altitude[10] is lower than the minimum operational altitude[11] of the GSO or non-GSO FSS space

[10] See item A.4.b.4.d of Appendix 4.

[11] See item A.4.b.4.f of Appendix 4.

station it communicates with and when the off-nadir angle between this GSO or non-GSO FSS space station and the non-GSO space station it communicates with is less than or equal to θ_{Max} (as defined in Annex 1 of this Resolution);

b) the GSO/non-GSO FSS space station receiving in the 27.5-30 GHz frequency bands and transmitting in the 18.1-18.6 GHz and 18.8-20.2 GHz frequency bands, or parts thereof, shall only operate space-to-space links when its minimum operational altitude is higher than the apogee altitude of the non-GSO space station with which it communicates;

c) the non-GSO space station communicating with a GSO or non-GSO FSS space station, shall remain under the characteristics envelop of the recorded assignments of the earth stations associated with the satellite network/system with which it is communicating;

d) that for the protection of the Earth exploration-satellite service (EESS) (passive) over oceans in the frequency band 18.6-18.8 GHz, the non-GSO FSS space station with an orbit of apogee less than 20 000 km, operating space-to-space links, and transmitting in the 18.1-18.6 GHz and 18.8-20.2 GHz frequency bands, when communicating with a non-GSO space station as described in resolves 1 a), shall operate as defined by the following: the out-of-band power flux density level produced at the surface of the Earth over oceans from a non-GSO FSS space station shall not exceed -126.4 dB(W/m^2/200 MHz) within the 18.6-18.8 GHz frequency band;

2 that non-GSO space stations subject to this Resolution receiving in the frequency bands 18.1-18.6 GHz and 18.8-20.2 GHz, or portions thereof:

a) shall not claim protection from FSS and MSS networks and systems as well as fixed and mobile stations operating in conformity with the Radio Regulations;

b) shall only receive the same emissions that are also being directed to earth stations from FSS space stations at higher orbital altitudes so that the interference environment can remain unchanged with respect to fixed and mobile stations, as well as to earth stations of other GSO and non-GSO FSS networks/systems from what is coordinated and notified in accordance with the Radio Regulations;

3 that GSO and non-GSO FSS space stations subject to this Resolution;

a) receiving in the frequency band 27.5-30 GHz from NGSO space stations shall not claim protection for these satellite-to-satellite transmissions from FSS and MSS networks and systems, as well as fixed and mobile stations operating in 27.5-29.5 GHz, and in conformity with the Radio Regulations;

b) shall comply with the provisions contained in Article **21** in the frequency band 18.1-18.6 GHz and 18.8-19.7 GHz to protect terrestrial services;

4 that non-GSO space stations transmitting in the frequency bands 27.5-30 GHz, or parts thereof:

a) shall not produce a power flux density at any point in the GSO arc greater than the power flux density produced by earth stations associated with the satellite network/system with which they communicate;

b) shall comply with the provisions contained in Annex 2 to this Resolution in the frequency band 27.5-29.5 GHz to protect terrestrial services;

c) shall only communicate with a GSO FSS space station when transmitting in the 29.1-29.5 GHz frequency band and shall only use a sun-synchronous orbit[12];

[12] Sun-synchronous orbits are identified by the Appendix 4 indicator A.4.b.4.m

d) shall not cause unacceptable interference to or otherwise impose constraints on operation or development of the non-GSO FSS service and protect non-GSO FSS space stations by complying with the provisions contained in Annex 3 to this Resolution;

5 that, in order to accommodate satellite-to-satellite transmissions, GSO and non-GSO FSS space stations receiving in the 27.5-30 GHz frequency bands and transmitting in the 18.1-18.6 GHz and 18.8-20.2 GHz frequency bands, or parts thereof, shall operate in compliance with the Radio Regulations and any existing coordination agreements between administrations,

resolves further

1 that, subject to this Resolution:

a) the notifying administration of the GSO FSS network receiving in the 27.5-30.0 GHz bands and transmitting in the 18.1-18.6 GHz, 18.8-20.2 GHz bands shall indicate to the Radiocommunication Bureau (BR), that it intends to include satellite-to-satellite operations for this GSO FSS network in accordance with this Resolution;

b) the notifying administration of the non-GSO FSS system receiving in the 27.5-29.1 GHz and 29.5-30.0 GHz bands and transmitting in the 18.1-18.6 GHz and 18.8-20.2 GHz bands shall indicate to the BR that it intends to include satellite-to-satellite operations for this non-GSO FSS system in accordance with this Resolution;

c) the notifying administration of the non-GSO FSS system receiving in the 27.5-28.6 GHz and 29.5-30.0 GHz bands shall indicate to the BR the commitment that the equivalent power flux-density produced at any point in the geostationary-satellite orbit by emissions from all combined operations of space-to-space and typical Earth station transmissions shall not exceed the limits given in Table 22-2;

d) the notifying administration of the non-GSO space station/stations transmitting in the 27.5-30.0 GHz bands towards a GSO FSS network and receiving in the 18.1-18.6 GHz and 18.8-20.2 GHz bands shall send to the BR, the relevant Appendix 4 advance publication information containing the characteristics of the non-GSO space station/stations and the associated name of the GSO FSS network with which it intends to communicate;

e) the notifying administration of the non-GSO space station/stations transmitting in the 27.5-29.1 GHz and 29.5-30.0 GHz bands towards a non-GSO FSS system at a higher orbital altitude and receiving in the 18.1-18.6 GHz and 18.8-20.2 GHz bands shall send to the BR, the relevant Appendix 4 advance publication information containing the characteristics of the non-GSO space station/stations and the associated name of the non-GSO FSS system with which it intends to communicate;

f) that in case of unacceptable interference caused by a non-GSO space station transmitting in the 27.5-30.0 GHz bands:

1. the notifying administration for the non-GSO space station transmitting in the 27.5-30.0 GHz bands shall cooperate with an investigation on the matter and provide, to the extent of its ability, any required information on the operation of the transmitting space station and a point of contact to provide such information;

2. the notifying administration for the non-GSO space station transmitting in the 27.5-30.0 GHz bands and the notifying administration of the GSO or non-GSO FSS network or

system with which the non-GSO transmitting space station communicates shall, jointly or individually, as the case may be, upon receipt of a report of unacceptable interference, take required action to eliminate or reduce interference to an acceptable level;

g) that the administration responsible for the GSO or non-GSO FSS network or system with which the non-GSO transmitting space station communicates shall ensure that:

1. for the operation of non-GSO space stations transmitting in the FSS (space-to-space) service in the 27.5-30.0 GHz bands, techniques to maintain pointing accuracy with the associated FSS satellite, without inadvertently tracking adjacent GSO satellites or non-associated non-GSO satellites, are employed;
2. all necessary measures are taken so that non-GSO transmitting space stations in the 27.5-30.0 GHz bands in the FSS (space-to-space) service are subject to permanent monitoring and control by a network control and monitoring centre (NCMC) or equivalent facility in order to comply with the provisions in this Resolution, and are capable of receiving and acting upon at least "enable transmission" and "disable transmission" commands from the NCMC or equivalent facility;
3. a permanent point of contact is provided for the purpose of tracing any suspected cases of unacceptable interference from non-GSO transmitting space stations in the 27.5-30.0 GHz bands in the FSS (space-to-space) service and to immediately respond to requests from the focal point;

2 that, upon receipt of the foregoing required information, the BR shall examine that information with respect to the existing regulatory provisions, as well as any conditions prescribed in this Resolution, and publish the result of such examination in the International Frequency Information Circular (BR IFIC),

instructs the Director of the Radiocommunication Bureau

1 to take all necessary actions to facilitate the implementation of this Resolution, together with providing any assistance for the resolution of interference, when required;

2 to report to future world radiocommunication conferences any difficulties or inconsistencies encountered in the implementation of this Resolution

3 that, upon examination of the information submitted by the notifying administration under resolves further 1d or 1e, if no recorded frequency assignments with typical earth stations for the relevant frequency bands can be identified for the GSO FSS network or NGSO FSS system with which the notifying administration's non-GSO space station intends to communicate, the BR shall return the information to the notifying administration with an unfavorable finding.

ANNEX 1 TO RESOLUTION [USA/A17/FSS SAT-TO-SAT] (WRC-23)

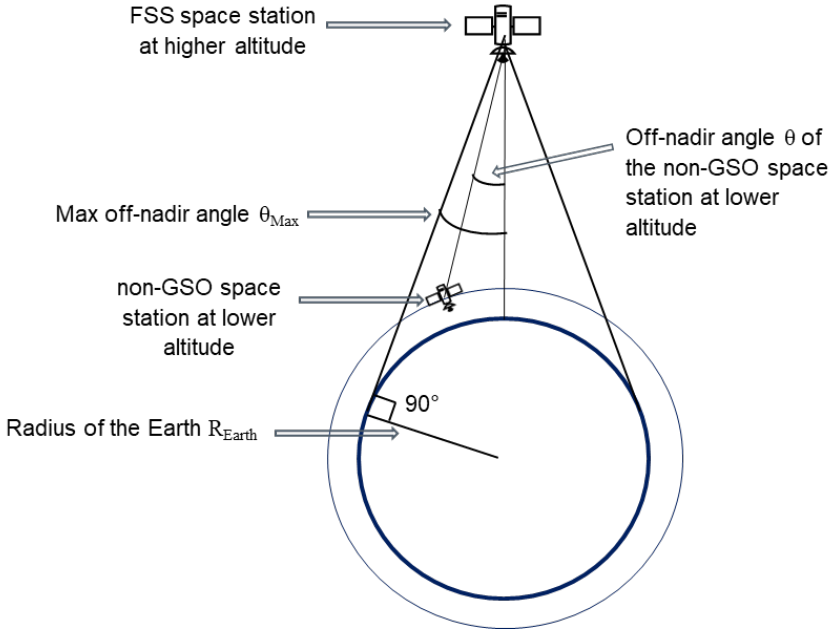
Determination of the off-nadir angle

1 a non-GSO FSS space station transmitting in the 27.5-30 GHz bands and receiving in the 18.1-18.6 GHz, 18.8-20.2 GHz bands shall only communicate with a GSO or non-GSO FSS space

station at a higher orbital altitude when the off-nadir angle between this GSO or non-GSO FSS space station and the non-GSO FSS space station it communicates with is less than or equal to:

$$\theta_{Max} = \sin^{-1}\left(\frac{R_{Earth}}{R_{Earth} + Alt_{Higher\_FSS}}\right)$$

where
R_{Earth} = 6378.145 km,
Alt_{Higher_FSS} = altitude of the GSO or non-GSO space station at higher orbital altitude in km



2 In case the notified service area of the GSO or non-GSO FSS network/system at higher orbital altitude is not global, the maximum off-nadir angle θ_{Max} will vary at each azimuth according to the notified service area and there will be a specific maximum off-nadir angle associated to each azimuth based on the position in space of the FSS network/system at higher orbital altitude and the geographic coordinates (latitude, longitude) of the border of the notified service area at each azimuth, which are extracted from the Graphical Interface Management System (GIMS) database container that was submitted to the BR when notifying a specific non-global service area.

$$\theta_{Max} = \cos^{-1}\left(\frac{\left(R_{Earth} + Alt_{FSS\_SS}\right)^2 + dist^2 - R_{Earth}^{\ 2}}{2 \times \left(R_{Earth} + Alt_{FSS\_SS}\right) \times dist}\right)$$

With

$$dist = \sqrt{(X_E - X_S)^2 + (Y_E - Y_S)^2 + (Z_E - Z_S)^2}$$

$$X_E = R_{Earth} \times \cos\left(lat_{sab}(\varphi)\right) \times \cos\left(lon_{sab}(\varphi)\right)$$
$$Y_E = R_{Earth} \times \cos\left(lat_{sab}(\varphi)\right) \times \sin\left(lon_{sab}(\varphi)\right)$$
$$Z_E = R_{Earth} \times \sin\left(lat_{sab}(\varphi)\right)$$

$$X_S = \left(R_{Earth} + Alt_{FSS\_SS}\right) \times \cos(lat_{SS}) \times \cos(lon_{SS})$$
$$Y_S = \left(R_{Earth} + Alt_{FSS_{SS}}\right) \times \cos(lat_{SS}) \times \sin(lon_{SS})$$
$$Z_S = \left(R_{Earth} + Alt_{FSS\_SS}\right) \times \sin(lat_{SS})$$

where:
$lat_{sab}(\varphi)$ = latitude of the service area border for the azimuth φ
$lon_{sab}(\varphi)$ = longitude of the service area border for the azimuth φ
lat_{SS}= latitude of the sub-satellite point of the GSO/non-GSO space station
lon_{SS}= longitude of the sub-satellite point of the GSO/non-GSO space station

ANNEX 2 TO RESOLUTION [USA/A17/FSS SAT-TO-SAT] (WRC-23)

Provisions for non-GSO space stations transmitting in the 27.5-30 GHz bands to protect terrestrial services in the frequency band 27.5-29.5 GHz

The maximum pfd produced at the surface of the Earth by emissions from a Non-GSO space station transmitting in the 27.5-30 GHz bands shall not exceed:

$pfd(\theta) = -115$ (dB(W/(m^2 · 1 MHz))) for $0° \leq \theta \leq 5°$

$pfd(\theta) = -115+0.5(\theta-5)$ (dB(W/(m^2 · 1 MHz))) for $5° \leq \theta \leq 25°$

$pfd(\theta) = -105$ (dB(W/(m^2 · 1 MHz))) for $25° < \theta \leq 90°$

where θ is the angle of arrival of the radio-frequency wave (degrees above the horizon).

ANNEX 3 TO RESOLUTION [USA/A17/ FSS SAT-TO-SAT] (WRC-23)

Provisions for non-GSO space stations transmitting in the 27.5-30.0 GHz bands to protect non-GSO FSS systems

The following conditions for non-GSO space stations transmitting in the 27.5-30.0 GHz bands to protect non-GSO space stations shall apply:

a) A non-GSO space station transmitting in the 27.5-29.1 GHz and 29.5-30 GHz bands towards a GSO FSS network shall never exceed the following on-axis e.i.r.p. spectral density limits:
   1. For non-GSO space station transmit on-axis antenna gains greater than 40.6 dBi: -17.5 dBW/Hz
   2. For non-GSO space station transmit on-axis antenna gains less than 40.6 dBi: -17.5 – (40.6 – on-axis gain of non-GSO space station antenna in dBi) dBW/Hz.

b) A non-GSO space station transmitting in the 29.1-29.5 GHz bands towards a GSO FSS network shall never exceed an on-axis e.i.r.p. spectral density of -20 dBW/Hz

c) A non-GSO space station transmitting in the 27.5-29.1 GHz and 29.5-30 GHz bands towards a non-GSO FSS system with a minimum operational altitude higher than 2000 km shall never exceed an on-axis e.i.r.p. spectral density of -20 dBW/Hz

d) For off-axis angles greater than the 3 dB beam width of a 30 cm antenna, the off-axis e.i.r.p. emissions of a non-GSO space station transmitting in the 27.5-29.1 GHz and 29.5-30 GHz bands to communicate with a non-GSO FSS system with a minimum operational altitude higher than 2000 km shall never exceed the envelope generated by the combination of an input power spectral density at the antenna flange of -62 dBW/Hz coupled with the off-axis gain derived from Recommendation ITU-R S.580-6 assuming an antenna size of 30 cm.

e) A non-GSO space station transmitting in the 27.5-29.1 GHz and 29.5-30 GHz bands towards a non-GSO FSS system with a minimum operational altitude lower than 2000 km shall never exceed an on-axis e.i.r.p. spectral density of -30 dBW/Hz

Reasons: Draft new WRC-23 Resolution provides the operating conditions for satellite-to-satellite operations in the fixed-satellite service to ensure protection of incumbent services operations.

SUP USA/4079A17/11

RESOLUTION 773 (WRC-19)

Study of technical and operational issues, and regulatory provisions for satellite-to- satellite links in the frequency bands 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz

Reasons: Adoption by WRC-23 of the aforementioned proposals satisfies the agenda item and therefore Resolution **773 (WRC-19)** is no longer needed.

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~~XVIII.~~XVII. **UNITED STATES OF AMERICA**

~~XIX.~~XVIII. **DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE**

AGENDA ITEM 7: *to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev.WRC-07)**, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary satellite orbit;*
Resolution **86 (Rev.WRC-07)** – *Implementation of Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference*

Topic D - *Modifications to Appendix 1 to Annex 4 of RR Appendix **30B***

BACKGROUND INFORMATION:

WRC-19 adopted modifications to Sections 1.1 and 1.2 of Annex 4 of RR Appendix **30B** by amending the minimum orbital separation between GSO satellite networks to be exceeded in order to be considered as unaffected and not be identified by the Bureau when performing its examination under § 6.5 of RR Appendix **30B**. The minimum orbital separations were changed from 10° and 9° to 7° and 6°, in §§ 1.1 and 1.2 of Annex 4 of RR Appendix **30B**, respectively. However, these modifications were not reflected in Section 2 of Appendix 1 to Annex 4 of RR Appendix **30B**.

This topic proposes to align Appendix 1 to Annex 4 of RR Appendix **30B** with the values of orbital separation in §§ 1.1 and 1.2 of Annex 4 of RR Appendix **30B**. With these modifications, the method proposed in Appendix 1 to Annex 4 of RR Appendix **30B** will be consistent with the changes approved in WRC-19.

Proposal

APPENDIX 30B (REV.WRC-~~19~~23)

Provisions and associated Plan for the fixed-satellite service in the frequency bands 4 500-4 800 MHz, 6 725-7 025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz

MOD USA/7D/1

APPENDIX 1 TO ANNEX 4 (REV.WRC-23)

Method for determination of the overall single-entry and aggregate carrier-to-interference value averaged over the necessary bandwidth of the modulated carrier

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~~XX.~~**XIX.** 2 AGGREGATE *C/I*

The aggregate $(C/I)_{agg}$ at a given downlink test point is given by:

$$(C/I)_{agg} = -10 \log_{10} \left(\sum_{j}^{n} 10^{-\frac{(C/I)_{tj}}{10}} \right) \quad \text{dB}$$

$$j = 1, 2, 3 \ldots n,$$

where:

$(C/I)_{tj}$: overall carrier-to-interference ratio due to interference from the j-th allotment or assignment calculated using the method for overall single-entry $(C/I)_t$ as provided in § 1 of Appendix **1** to this Annex; and

n: total number of interfering allotments or assignments for which the orbital separation with the desired satellite is less than or equal to 7~~10~~° in the case of the 6/4 GHz band and less than or equal to 6~~9~~° in the case of the 13/10-11 GHz band.

Reason: To align Appendix 1 to Annex 4 of RR Appendix 30B with the WRC-19 approved values of orbital separation contained in §§ 1.1 and 1.2 of Annex 4 of RR Appendix 30B.